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VOL. CXXXVII.—No. 3563] LONDON: FRIDAY EVENING, APRIL 11, 1924 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY ISLAND POST 1s. 3d.

The Engineer

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350 Ton Floating Crane for Japan (With a Two-Page Supplement).

High-Tension Transmission Lines—No. V.

Institution of Naval Architects.

Efficiency Standards for Internal Combustion Engines.

The Resaca of Rio de Janeiro.

The Motorship Dolius.

Portland Cement Works on the Humber (No. III.)

Thermodynamics and Practice.

Empire Naval Defence.

PUBLIC NOTICES

Ministry of Transport.

CONSTRUCTION OF BARKING BRIDGE.

The Minister is prepared to receive TENDERS for the CONSTRUCTION of the BRIDGE over Barking Creek on the line of the East Ham and Barking By-pass.

Specification, bills of quantities, forms and conditions of Tender and contract may be obtained from the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W. 1, upon payment of a deposit of One Hundred Pounds. This amount will be returned to the tenderer if his Tender is a bona fide one and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.

The drawings may be inspected at the Ministry and copies of the forms and conditions of Tender and contract, specification and bill of quantities, will be available on and after Wednesday, the 16th April, 1924.

Tenders, on the official form and accompanied by a fully priced bill of quantities, must be submitted and enclosed in a sealed envelope endorsed "Tender for Barking Bridge."

The Minister does not bind himself to accept the lowest or any Tender.

Tenders must reach the undersigned by 10 a.m. on the 8th day of May, 1924.

Dated this second day of April, 1924.

(Sd.) H. H. PIGGOTT,
Assistant Secretary.

Ministry of Transport. 5475

Assistant Engineers Required

by the GOVERNMENT of the GOLD COAST, for Coomassie Waterworks, for a tour of 12 to 18 months' service, with possible extension. Salary £480 a year for the first three years of service, then, if taken on the permanent staff, £510, rising to £720 a year by annual increments of £30, and thereafter to £810 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, age 25 to 35, should be students or associate members of the Institution of Civil Engineers, or of the Institution of Water Engineers, should be thoroughly practical surveyors and have been trained under a waterworks engineer of standing, and have had experience in the design and construction of reinforced concrete dams, filter works, &c.—Apply at once, by letter, stating age and giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting at the top of application M/12,684. 5476

University of Liverpool.

FACULTY OF ENGINEERING.

DEAN: Professor T. H. ARDILL, O.B.E., M.Eng., R.C.N.C. Ext., M. Inst. N.A.

The University awards the Degrees of B.Eng., M.Eng., D.Eng., Ph.D., and a Certificate and Diploma in Engineering.

Degree Candidates must pass an approved Matriculation Examination. Candidates for a Certificate (which leads to a Diploma) must have (i) been engaged in Practical Engineering, (ii) followed approved courses in a Technical School.

The Courses are designed for students desiring to qualify as MECHANICAL, ELECTRICAL, CIVIL or MARINE ENGINEERS, as NAVAL ARCHITECTS and METALLURGISTS or METALLURGICAL ENGINEERS. The Courses cover the subjects of examination for Associate Membership of the Institutions of Civil, Mechanical and Electrical Engineers. The Institutions named, subject to certain conditions, accept the Degree of B.Eng. in lieu of part, and in some cases the whole, of the examinations for Associate Membership. The various Departments are housed in commodious and well-equipped buildings, and provide ample facilities for research.

A prospectus of the Faculty, giving particulars of Courses and a large number of Entrance and Post-graduate Scholarships, may be had on application to the undersigned.

† EDWARD CAREY,
Registrar.

5454

Aberdeen Corporation Water-Works.

EXTENSIONS, 1920.
CONTRACT NO. 18—PIPING.

The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the MANUFACTURE and DELIVERY of about 3500 LINEAL YARDS of 20in., 24in., 16in., and 12in. diameter PIPES and SPECIALS of the following alternative types, viz.:—

(A) CAST IRON.
(B) MILD STEEL (LAP WELDED).

The drawings may be inspected and specification, schedule of quantities and form of Tender obtained on and after 11th April, 1924, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen. Early application is desirable and no specification will be given out after 21st April.

For each specification a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification, and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.

The employment of labour shall be in accordance with the conditions of the Unemployment Grants Committee.

Tenders, on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for Piping," are to be addressed to the undersigned. No Tender delivered after Noon on 28th April, 1924, will be considered.

The Town Council do not bind themselves to accept the lowest or any Tender.

GEORGE MITCHELL, M. Inst. C.E., F.G.S.,
Water Engineer.

Water Engineer's Office,
41½, Union-street, Aberdeen.
7th April, 1924. 5488

County Borough of Bury.

ELECTRICITY DEPARTMENT.

The Electricity Committee have FOR SALE TWO Belliss and Morcom TRIPLE-EXPANSION ENGINES, coupled to 250-K.W. D.C. 460/550-volt Compound-wound Siemens GENERATORS, complete with Steam-driven Jet-condensing Plant, Pumps, and Pipework. Steam pressure, 180 lb. per sq. inch, speed 375 revs. per minute. This plant can be inspected by arrangement, and full particulars can be obtained from the undersigned.

J. G. POTTS,
Borough Electrical Engineer.

Electricity Works,
Rochdale-road, Bury. 5459

County of London.

The London County Council invites TENDERS for the SUPPLY, DELIVERY, and ERECTION of HIGH-TENSION SWITCHGEAR, CONTROL PANELS and CONNECTIONS for Greenwich Power Station.

The specification, form of Tender, and general conditions may be obtained from the General Manager, London County Council Tramways, Victoria Embankment, W.C. 2, upon payment of a deposit of £2 (Two Pounds). This amount will be returnable only if a bona fide Tender is submitted and not withdrawn. Particulars of the work may be obtained at the Tramway Offices, Victoria Embankment, before payment of the deposit.

Tenders must be delivered to the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m., on Monday, 5th May, 1924. No Tender received after that time will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the London County Council.

5480

County Borough of Warrington.

ELECTRICITY DEPARTMENT.

The Electricity and Tramways Committee invite TENDERS for STEAM PIPES and WATER PIPES.

Specification and form of Tender can be obtained from F. V. L. Mathias, M.I.E.E., Borough Electrical and Tramways Engineer, Howley, Warrington, on payment of One Guinea, which will be returned on receipt of a bona fide Tender. Five Shillings each will be charged for extra copies of specification.

Cheques to be made payable to the Borough Treasurer, Warrington.

Tenders, addressed to the Chairman of the Electricity and Tramways Committee, Town Hall, Warrington, must be sealed with wax and endorsed "Tender for Pipes," and delivered not later than Twelve o'clock Noon on Tuesday, April 29th, 1924.

The Committee do not bind themselves to accept the lowest or any Tender.

A. T. HALLAWAY,
Town Clerk.

Town Hall, Warrington. 5460

Hull Corporation.

WESTERN RING ROADS—RAILWAY BRIDGE.

TO PUBLIC WORKS CONTRACTORS AND STRUCTURAL ENGINEERS.

The Corporation are prepared to receive TENDERS for a RAILWAY BRIDGE in connection with the Western Ring Roads. The work consists of Abutments, Wing Walls, Piling, &c., and Steel Frame Girders, Flooring, &c.; total weight of steel work 232 tons. Contractors shall Tender for the whole of the work, but a public works contractor may submit the steel work, and similarly, a contractor of structural steel work may submit the abutments, wing walls, piling &c.

Forms of Tender and other particulars can be obtained at the City Engineer's office after the 12th April on payment of £1, which will be returned to firms submitting a bona fide Tender. Prints of the six contract plans can be obtained on payment of 15s., not returnable.

Remittances must be made payable to Mr. T. G. Milner, City Treasurer and Accountant.

Tenders, endorsed "Tender for Bridge, Western Ring Roads," are to be addressed to the Chairman of the Works Committee, and delivered at the Town Clerk's office before Noon on Wednesday, the 23rd April.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order,
F. W. BRICKNELL, M. Inst. C.E.,
City Engineer.

Guildhall, Hull,
3rd April, 1924. 5476

PUBLIC NOTICES

Metropolitan Water Board.

SUPPLY OF POSITIVE TYPE WATER METERS.

The Metropolitan Water Board invite TENDERS for the SUPPLY of FIFTY 1in. POSITIVE TYPE WATER METERS, delivered to the Board's works at Kingsman-street, Clerkenwell, E.C. 1.

Forms of Tender may be obtained from the Chief Engineer by personal application (Room 155) or upon forwarding a stamped addressed brief envelope.

Tenders must be made on the official form, enclosed in sealed envelopes and addressed to the "Clerk of the Board, Metropolitan Water Board, New River Head, Rosebery-avenue, E.C. 1," endorsed "Tender for Water Meters," and delivered at the offices of the Board not later than 11 a.m. on Wednesday, 16th April, 1924.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
New River Head,
173, Rosebery-avenue, E.C. 1,
5th April, 1924. 5467

Siam State Railways.

NOTICE.

SEALED TENDERS for the SUPPLY of STEEL RAILS and FISH PLATES will be received at the Offices of the SIAM STATE RAILWAYS, Bangkok, until Fourteen o'clock on 1st July, 1924, at which place and hour the Tenders will be publicly opened and read.

Tender forms, &c., may be obtained from Messrs. C. P. Sandberg, 40, Grosvenor-gardens, London, S.W. 1, upon payment of £1 10s. per set, which sum will not be refunded.

Right is reserved to reject any or all Tenders and to accept any Tender which, in the opinion of the Board of Railway Commissioners, is to the best interests of the Siam State Railways.

Bangkok, March 1st, 1924. 5466

TO PIPE FOUNDERS.

The Fylde Water Board Invite

TENDERS for the SUPPLY and DELIVERY of about 23,000 TONS of 27in. and 25in. CAST IRON SOCKET and SPIGOT PIPES, and about 280 TONS of SOCKET and SPIGOT and FLANGED SPECIALS.

An alternative TENDER is INVITED for the above PIPES in CAST IRON LINED with CONCRETE.

Specification can be obtained from the undersigned.

The Board do not bind themselves to accept the lowest or any Tender.

JNO. COOK,
Engineer.

Sefton-street, Blackpool,
8th April, 1924. 5480

Torquay Town Council.

WATERWORKS DEPARTMENT.

The Council of the Borough of Torquay is prepared to receive TENDERS for the LAYING and JOINTING of about 3¼ MILES of 12in. and ¼ MILE of 7in. CAST IRON PIPES, SPECIAL CASTINGS, and ANCILLARY WORKS.

Specifications and schedules may be obtained on application to the undersigned on payment of a deposit of Two Guineas, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for New Trunk Main, Contract No. 13," together with the specification and schedule of prices, must be delivered to the Town Clerk at his office, Town Hall, Torquay, before Noon, 28th April, 1924.

The Council does not bind itself to accept the lowest or any Offer.

SAMUEL C. CHAPMAN, M. Inst. C.E.,
Waterworks Engineer.

Town Hall, Torquay,
7th April, 1924. 5490

PUBLIC NOTICES

Parish of Lambeth: Board of Guardians.

The Guardians of the Poor of the Parish of Lambeth are prepared to receive TENDERS for the SUPPLY of FIRE EXTINCTEURS. Printed forms of Tender, with conditions annexed, together with detailed specification, may be obtained upon application to the undersigned. Tenders are returnable on or before Tuesday, 29th instant. The Guardians do not pledge themselves to accept the lowest or any Tender.

By Order,
JAMES L. GOLDSPINK,
Clerk to the Guardians.

Guardians' Offices,
125, Brook-street, Kennington, S.E. 11.
9th April, 1924. 5517

The Municipality of Singapore.

TENDER FOR STEEL PIPES, VALVES, &c.

Sealed TENDERS, addressed to Messrs. C. C. Lindsay and Peirce, 180, Hope-street, Glasgow (Agents to the Municipality of Singapore), endorsed "Singapore Municipality, Tender for Steel Pipes, Valves, &c.," will be received until 5 p.m. on Wednesday, the 23rd April, 1924, for the SUPPLY and DELIVERY at Singapore of about 4½ MILES of WELDED STEEL PIPE, 38in. internal diameter about 4½ MILES of WELDED STEEL PIPE, 34in. internal diameter; about 4 MILES of WELDED STEEL PIPE, 30in. internal diameter, together with certain CAST IRON PIPES, VALVES, and SPECIALS. Though lap-welded steel pipes are specified, tenderers are at liberty to offer other makes of steel pipes, but riveted pipes will not be accepted, and whatever make of pipe may be offered must be of British material and manufacture.

Forms of Tender and specifications may be obtained from Sir Alex. Binnie, Son and Deacon, 39, Buckingham-gate, Westminster, S.W. 1, or from the Agents to the Municipality on receipt by either of them of a cheque to the value of £5, made out to the Agents, Messrs. C. C. Lindsay and Peirce, which amount will be returned on receipt of a bona fide Tender. Drawings may be seen at the offices of Messrs. Sir Alex. Binnie, Son and Deacon.

The lowest or any Tender will not necessarily be accepted, nor will any expenses in connection with tendering be defrayed. No Tenders will be considered except from actual manufacturers, capable of supplying the pipes at the rate of 100 of each size per fortnight.

C. C. LINDSAY and PEIRCE,
180, Hope-street, Glasgow
Agents to the Municipal Commissioners of Singapore.
5391

Wandle Valley Joint Sewerage Board.

TO CONTRACTORS AND DEALERS IN MACHINERY, &c.

The above Board invite TENDERS for the PURCHASE, DISMANTLING, and REMOVAL of BOILERS, STEAM and GAS ENGINES, and PUMPING MACHINERY, &c., at their Sewage Works, Bygrove-road, Merton, S.W. 19, in accordance with the general conditions prepared by Messrs. Wilson and Raikes, Engineers, of London and Birmingham.

Full particulars, together with forms of Tender and permit to view, may be obtained on application to the undersigned, to whom Tenders should be delivered on or before Monday, May 12th next.

ROBT. M. CHART,
Clerk and Surveyor to the Board.

Lower Green, Mitcham, Surrey. 5515

Borough of Richmond (Surrey).

WATER ENGINEER AND MANAGER.

The Town Council invite APPLICATIONS for the APPOINTMENT of ENGINEER and MANAGER to the Borough Waterworks Undertaking.

Candidates must be Associate Members of the Institution of Civil Engineers.

Age not to exceed 40 years.

Salary £600 per annum (no bonus), with residence, fuel, and light provided by the Council.

The Superannuation, &c., Act, 1922, is in operation in the Borough, and the appointment will be made subject to the candidate appointed passing satisfactorily an examination by the Medical Officer of Health within seven days of his appointment. He will also be required to contribute to the Superannuation Scheme.

The appointment will be subject to one month's notice on either side.

Applications (which must be made on a form which on request, will be sent to intending candidates), accompanied by copies of not more than three recent testimonials, must reach the undersigned not later than Tuesday, the 29th April, 1924.

Personal canvassing is strictly prohibited.

HENRY SAGAR,
Town Clerk.

Town Hall, Richmond, Surrey,
8th April, 1924. 5516

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PUBLIC NOTICES

East Indian Railway.

ASSISTANT ENGINEERS are REQUIRED for service in India, and the Directors are prepared to receive APPLICATIONS for APPOINTMENTS by letter only.

Candidates must have received a good scientific education at a recognised Engineering College and have passed the examination for Associate Membership of the Institution of Civil Engineers or hold an exempting degree.

Preference will be given to candidates who have had some practical experience on railway maintenance or on construction.

Salary according to qualifications and experience, with a 4 years' agreement and a first-class passage to India.

The selected candidates will be required to pass a medical examination by the Company's Consulting Physician before appointment.

Applications should be accompanied by a brief record of the candidate's career in chronological order, giving particulars of general and technical education and subsequent experience, with dates, and should be addressed to the undersigned not later than Saturday, the 26th April, 1924. Copies (not originals) of any testimonials should also be sent.

By Order,
G. H. LILLIE,
Secretary.

73-76, King William-street,
London, E.C. 4.
9th April, 1924. 5506

Singapore, Straits Settlements.

WATER DEPARTMENT.
ASSISTANT SUPERINTENDENT OF WATER MAINS AND SERVICES.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT SUPERINTENDENT of MAINS and SERVICES in the Water Department, age about 25 to 30, unmarried, on a three years' agreement, with possible extension. Preference will be given, other things being equal, to ex-Service men. Applicants must be "Registered Plumbers," with experience in the work of a mains and services department under a water authority in the United Kingdom, and must be accustomed to carrying out the Model By-laws and Regulations. They should be accustomed to controlling men, and experience in a workshop and in training men will be an advantage. A bonus of 50 dollars will be given on the selected candidate's passing successfully an examination in colloquial Malay within twelve months of his arrival in Singapore. Salary 4560 dollars for the first, 5040 dollars for the second, and 5520 dollars for the third year, paid monthly in dollars, the currency of the Colony, the value of the dollar being two shillings and fourpence sterling. If re-engaged, the candidate, in his fourth year, would probably be placed in Class 6 of the salary scheme, in which the annual increments are 60 dollars per month and the maximum salary 540 dollars per month. The pay of the appointment for the first year at the above rate would be about £532. Such local transport allowance as may from time to time be sanctioned by the Commissioners will be paid. Free passage will be provided, with half-pay during the voyage out. The selected candidate must pass a medical examination. Applications, stating whether married or single, age, and place of birth and giving details of education, apprenticeship, training, and experience generally, with war service, and referring to all the above requirements in detail, accompanied by copies (only) of testimonials and also personal references, are to be lodged with Messrs. C. C. LINDSAY and PRIECE, MM. Inst. C.E., 180, Hope-street, Glasgow, Agents for the Commissioners (who will give further particulars if requested), not later than Tuesday, 22nd April. 5490

SITUATIONS OPEN

WANTED, ASSISTANT in Engineer's Office. Fully conversant with Signalling and Interlocking; good draughtsman.—Apply, stating age, experience, and salary required, to the CHIEF ENGINEER, Dublin and South-Eastern Railway, Westland-row, Dublin. P8962 A

WANTED, DESIGNING ENGINEER for Large Iron and Steel Works.—Address, 5473, The Engineer Office. 5473 A

WANTED, MANAGER for Riveted Boilerworks. Must be young and experienced in Vertical Steam Boilers, Air Receivers, &c.—Address, giving age, experience, and salary required, 5448 The Engineer Office. 5448 A

WANTED, Well-educated Young MAN of Good address, 25-30, to Assist Works Manager of Motor Car Works, with outside contract work. Must be fully qualified engineer, technically trained, and have had experience in the following branches: machine shop, erecting, estimating or rate fixing, jig and tool design for quantity production; able to put concrete facts respecting quotations, &c., before his principal. Splendid training for ambitious and live man. Salary £350 per annum. State age and full particulars of experience.—Address, 5441, The Engineer Office. 5441 A

AERIAL ROPEWAYS.—THREE First-class DESIGNERS REQUIRED AT ONCE. None need apply except thoroughly experienced in both systems. Applicants should state experience in full detail, salary required, and when at liberty.—Address, P8958, The Engineer Office. P8958 A

EXPERIENCED BOILER INSPECTOR WANTED at large Chemical Works, for Testing and Inspecting all Pressure Vessels, Hoists Plant, &c. State full particulars of experience and salary required.—Address, 5487, The Engineer Office. 5487 A

RATE FIXER and DEMONSTRATOR REQUIRED for Machining Department of Midlands Firm of Steel Forgings Manufacturers specialising in Crank Shafts. Essential qualifications include expert knowledge of machining times and ability as a practical demonstrator from actual experience of above class of work.—Address, 5445, The Engineer Office. 5445 A

REQUIRED for Railway on West Coast of South America, as ASSISTANT CIVIL ENGINEER, with good railway construction experience, preferably in South America. Salary £550 p.a. Three years' contract, free passage out and home; free quarters provided.—Write full particulars to "Z. X.," c/o Messrs. Charles Barker and Sons, Ltd., 31, Budge-row, Cannon-street, London, E.C. 4. 5506 A

REQUIRED IMMEDIATELY for High-class Wood-working Machinery Manufacturers, REPRESENTATIVE for Southern Counties, with good connection preferred.—Address, stating age, previous experience, salary, and commission required, 5512, The Engineer Office. 5512 A

WORKS MANAGER, ASSISTANT or UNDERSTUDY.—APPLICANTS are INFORMED that the VACANCY advertised in this Journal on February 22nd and 29th, over Box No. 4078, is now FILLED. 5494 A

WANTED, a First-class COLLIERY CHIEF DRAUGHTSMAN, to act as General Assistant to Chief Engineer at large collieries. Only thoroughly experienced and highly trained men need apply, stating full details of training, experience, and wages required.—Address, P8950, The Engineer Office. P8950 A

WANTED, CIVIL ENGINEERING DRAUGHTSMAN, not exceeding 30 years of age. Must be energetic and able to fit in existing organisation. Good salary to the right type of man.—Address, 5509, The Engineer Office. 5509 A

WANTED, First-class DRAUGHTSMAN for the North of England, with experience in the design of machinery for Stone Crushing, Screening and Cement Making and the Lay-out of complete Plants.—Address, 5470, The Engineer Office, stating details of experience, age, and salary expected. 5470 A

WANTED IMMEDIATELY, Competent DRAUGHTSMAN, experienced in Coal Screening and Washing Plant and General Colliery Work.—Apply, giving full particulars of experience, age, and salary required, to SHEPPARD and SONS, Ltd., New Foundry, Bridgend, S Wales. 5469 A

SITUATIONS OPEN (continued)

WANTED, SENIOR DRAUGHTSMAN, with Turbine experience, for Tyneside Firm. State age, experience, and salary required.—Address, 5451, The Engineer Office. 5451 A

WANTED, Thoroughly Experienced Leading LOCOMOTIVE DRAUGHTSMAN, North-East Coast area.—Address, stating age, previous experience, and salary required, 5496, The Engineer Office. 5496 A

DRAUGHTSMAN REQUIRED AT ONCE, with sound experience of Constructional Steel Work for London buildings. Must have been several years as draughtsman with constructional firm.—H. YOUNG and CO., Ltd., Thorndyroft House, Smith-square, Westminster, S.W. 5514 A

DRAUGHTSMAN REQUIRED for Engineer's London office for designing project drawings of Ore-carrying Plants for Coal, Ore, &c. Previous experience in this class of work essential. No others need apply. State experience, age, and salary required.—Address, 5513, The Engineer Office. 5513 A

DRAUGHTSMAN REQUIRED, Leeds District; first-class experience essential, used to design of Front and Rear Axles for Touring Cars and Commercial Vehicles. State age, experience, and salary required.—Address, 5495, The Engineer Office. 5495 A

DRAUGHTSMAN, Thoroughly Experienced, Particulars as to age, salary, and experience.—VAUGHAN CRANE CO., Ltd., Openshaw, Manchester. 5492 A

DRAUGHTSMAN WANTED, Good Mechanical Experience essential. Knowledge of Coke Oven Machinery an advantage. Age, experience, and salary expected.—Address, 5471, The Engineer Office. 5471 A

FIRST-CLASS DRAUGHTSMEN WANTED, London Engineer's Office, for Power Station Lay-out and Detail Work (Steam Generator Plant); experience essential.—Address, 5449, The Engineer Office. 5449 A

GOOD DRAUGHTSMAN WANTED, Well Up in Mining Metallurgical Work.—State experience and salary required by letter to FRASER and CHALMERS ENGINEERING WORKS, Erith. 5456 A

MECHANICAL and GENERAL ENGINEERING DRAUGHTSMEN REQUIRED, to Prepare Detail Drawings and Schemes in drawing-office of large manufacturing works in the Midlands. The following training is essential:—

At least two years' day student in recognised College or University, College Diploma or Engineering Degree, and three years in workshop of well-known firm of general engineers; at least three years' drawing-office experience.

Address in confidence, stating age, training, experience, salary required, and when at liberty, 5459, The Engineer Office. 5459 A

REQUIRED, DRAUGHTSMAN, with Experience of Factory Repairs to work under engineer's supervision. Must be able to make drawings clearly without excessive supervision.—Address, with full particulars as to salary required, age, experience, references, &c., P8949, The Engineer Office. P8949 A

REQUIRED, Good Mechanical DRAUGHTSMEN for London.—Application by letter only, giving particulars of age, experience, salary expected, to VICKERS LIMITED, Vickers House, Broadway, Westminster. 5463 A

SEVERAL Capable DRAUGHTSMEN WANTED, preferably with experience in designing Light Mechanical Motions or Automatic Machinery.—State age, experience, and salary to Box 714, Advertising Offices 84, Queen Victoria-street London. 5497 A

SEVERAL First-class STRUCTURAL DRAUGHTSMEN WANTED by Firm on North-East Coast. Must be capable of detailing, checking and taking charge of orders. Only experienced men need apply. State age, salary required, and when at liberty.—Address, 5446, The Engineer Office. 5446 A

WANTED, a FOREMAN, Capable of Taking Charge of a Structural and Plating Department of Engineering Works in the North-East District. Applicants must have had modern, up-to-date experience in the control of men, and with a special knowledge of General Structural and Plating Work. Accustomed to Fixing Piece-work Rates and Estimating to obtain work. This should prove a good position to a progressive, pushful man.—Address, stating age, experience and full particulars, 5288, The Engineer Office. 5288 A

FOREMAN ELECTRICAL ENGINEER WANTED in Liverpool District, to be responsible for keeping a large plant in running order, and with previous experience in this direction. Good salary for capable man. State age, experience, and salary required.—Write, Box P846, Lee and Nightingale, Advt. Offices, Liverpool. 5458 A

FOREMEN ERECTORS, Used to Heavy Electrical Machines, Switchgear and Cables for contract work at home and/or abroad. State particulars of experience, age and if married.—Address, 5305, The Engineer Office. 5305 A

REQUIRED, Experienced ASSISTANT LOCOMOTIVE FOREMAN for short railway in South America. Must have had good education and speak Spanish.—Write, stating age, experience, &c., to "Z. Y. X.," c/o Street's, 6, Gracechurch-street, London, E.C. 3. 5502 A

WANTED, Capable FITTER and MACHINIST for General Engineering Shop in East London.—Address, P8946, The Engineer Office. P8946 A

SITUATIONS WANTED

A YOUNG ENGINEER (Age 23), with Full Apprenticeship in leading engineering firm, SEEKS SUITABLE POSITION; experience in pattern, foundry, fitting and constructional shops and drawing-office; college education.—Address, P8942, The Engineer Office. P8942 B

ENGINEER (27), 1st Class B.O.T. Certificate. Experience with oil fuel, turbine, reciproc. engine, electric light, REQUIRES POST; good general engineering knowledge.—FRANK H. LOCKWOOD, 60, Gautlen-road, Hammersmith, W. 6. P8969 B

ENGINEER (36), Fitter and Turner, SEEKS SITUATION; 20 years' good all-round experience, maintenance or works; excellent refs.—J. Z., 81, Pekin-street E. 14. P8959 B

ENGINEER (25), B.Sc., Hons. Civ. Eng. (Manchester), apprenticeship Vickers, twelve months' general office experience, correspondence, estimates, would like TECHNICAL APPOINTMENT with Consulting or Contracting Bridge or Dock or Harbour Works Engineers. Applicant desires to qualify for A.M.I.C.E. and expects hard work. London district if possible.—Address, P8966, The Engineer Office. P8966 B

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Full details would be given in confidence at a personal meeting by appointment.

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8398 B LONDON, W.C. 2.

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THE OWNERS of PATENTS Nos. 152,045, 152,046, and 152,047, relating to "Telemotors," DESIRE to LICENSE or SELL the PATENT RIGHTS in Great Britain.—Address, E. F. ALEXANDER and SON, 306, High Holborn, London, W.C. 1. 5452 F

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BORE-HOLE PUMP.—WANTED to HIRE for a few months; lift 130ft., 30,000 to 35,000 gallons per hour from 20in. bore-hole. Steam or oil drive.—Offers to Mr. W. MATTHEWS, 36, Westwood-road, Southampton. P8952 F

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The French Navy.

THE French Senate has sanctioned the putting in hand of the second part of the programme of naval construction, comprising six fast cruisers of 10,000 tons, fifteen destroyers, two submarine cruisers, and thirty-five first-class submarines, as well as torpedo boats, minelayers, and other craft. At first it was feared that the Senate would have deferred its sanction on the ground of the necessity for reducing expenditure, but public opinion feels so strongly the urgency of strengthening the navy that special efforts are to be made to accelerate the execution of the programme. The Government is also being exhorted to push through the Naval Statute Bill which was introduced into the Chamber of Deputies last year. The Army Statute Bill, recently passed, provides for the transport from North Africa to France in time of emergency of at least three-quarters of a million troops, and there must consequently be an absolutely safe seaway, which it was hoped would have been rendered secure by the fleet of fast cruisers, destroyers and submarines now under construction, assisted, of course, by aircraft; but the British naval manœuvres in the western part of the Mediterranean showed that a much greater force would be necessary than that originally estimated. The British manœuvres, in fact, caused amongst the French a disagreeable surprise. The fear that it may not be possible after all to keep open an absolutely safe route across the Mediterranean has influenced opinion in the direction of seeking some co-operation with Great Britain, while the suggestion that the League of Nations should entrust certain Powers with naval control is only accepted by the French on the understanding that the control shall be vested in the Powers according to the interests involved, which means that France would claim authority over the western part of the Mediterranean. As the policy of France is to draw troops from North Africa, it is claimed that the Mediterranean is a continuation of the Rhine frontier. Any future distribution of naval forces is likely, therefore, to give rise to considerable controversy.

Speeds of Atlantic Liners.

IT is reported that the Atlantic Conference of Transatlantic Steamship Lines, which meets in Brussels, has given the place of honour to the Leviathan, of the United States Lines, for maintaining the highest average speed during the 1923 season. In the returns which are given as official Conference figures, the various fast ships on the North Atlantic run are arranged in the following order:—Leviathan, first with an average speed of 23.57 knots; Mauretania, second with 23.51 knots; Majestic, third with 23.29 knots; Aquitania, fourth with 22.65 knots; Berengaria, fifth with 22.27 knots; and Olympic, sixth with 21.44 knots. This list has given rise to comment on the part of British shipping interests, and it has been rightly pointed out that the Leviathan was only in service during part of the season, namely, from July to December, whereas all the other liners mentioned in the report sailed regularly throughout the year. It is certain that the severe weather which is encountered in the early winter and spring months imposes conditions which seriously affect the maximum speed at which a ship can be run with comfort and safety. This factor should certainly be taken into account before any final comparison is made. If the matter is viewed in a proper light we have no doubt that the supremacy of the Mauretania will be vindicated.

Electric Furnaces.

SOME useful information on electric furnaces was given in a paper read a few days ago before the Birmingham Metallurgical Society by Mr. A. G. Lobley. Modern electric furnaces, the author said, were quite reliable, but the capital cost was often unnecessarily high. On the other hand, where electricity could be obtained at a reasonable price, the running costs were by no means heavy. By improving the load and power factors, the author explained, electric furnaces would tend to reduce the cost of electricity. The lecturer gave an account of his personal experience in the design and use of metallic "resistor" furnaces, ranging from small laboratory types to industrial annealing furnaces. An account was given of the principles governing the design of these furnaces and the methods of winding and connecting the elements.

A British Geared Turbine Locomotive.

AN interesting locomotive exhibit at the forthcoming Wembley Exhibition will be the new geared turbine condensing locomotive, which has recently been completed at the works of the North British Locomotive Company, Limited, at Springburn, Glasgow. This locomotive, constructed under the Reid-MacLeod patents, is the first of its kind to be built in Great Britain. It embodies important mechanical improvements. The design provides for longitudinally placed two-stage turbines and a condenser, and all coupling-rods are dispensed with, the drive being rotary throughout. The absence of reciprocating parts confers better balance, and will, it is stated, permit of heavier wheel loads being used, while the uniform torque of the turbine gives a rapid acceleration equal to that obtained with electric traction. Forced draught is employed and is stated to give a combustion control which may be varied to meet different loads and speeds. A closed system of forced lubrication is fitted which should tend to reduce wear and tear. It is estimated that an economy of both fuel and water of about 50 per cent. will be attained. This locomotive is, of course, not to be confused with the Reid-Ramsay turbine locomotive built at the same works in the years before the war, or with the somewhat similar locomotive constructed by the Ramsay Engineering Company a year or two ago which was tested at Horwich.

American Navy Estimates.

THE United States Naval Appropriation Bill for the new fiscal year provides a sum of 294,442,867 dollars for naval defence. This figure is 36,000,000 dollars less than the amount voted last year, and is the smallest appropriation for the navy which has been made since the year 1916. Beyond a few gunboats for service on the Chinese rivers, no new construction can be laid down in the immediate future. The programme of eight 10,000-ton cruisers appears to have been accepted by Congress, but the credits required for beginning work on these ships have yet to be voted. The three cruiser-submarines and the three minelaying submarines asked for by the Navy Department were not approved. In a statement justifying the deletion of these vessels, Mr. B. L. French, Chairman of the Sub-committee on Appropriations, said that the three "fleet submarines" completed in 1920–22 "are tied up at Hampton Roads out of commission, because their engines do not perform adequately." He also quoted a report by the Chief of Naval Operations, condemning the performance of these three boats, T 1 to T 3, as unsatisfactory. For this reason the vote for new submarines was struck out, while, at the same time, 600,000 dollars was appropriated for the construction and test of a heavy oil engine suitable for driving large submarines. Nearly 5,000,000 dollars are voted for improving the main and auxiliary machinery of capital ships now in commission, this sum being 2,000,000 dollars more than the minimum sum recommended by the Bureau of Engineering. Part of the money will be spent in converting coal-burning battleships into oil-burners. The authorised establishment of lower-deck *personnel* remains at 86,000, an increase having been refused on the singular ground that "enlisted *personnel* can be trained in a comparatively short time."

Non-Ferrous Metals Research.

AT a luncheon which followed the annual meeting of the British Non-Ferrous Metals Research Association, which was held in Birmingham last Friday, Mr. Thomas Bolton, the president, uttered a warning against the too lavish use of non-ferrous metals on account of the fact that supplies might before very long be exhausted. On the other hand, he suggested that it was not inconceivable that before the time came when these resources were exhausted, we might gain such intimate knowledge and possible control of the internal structure of our materials that the transmutation of metals would be no longer the dream of the alchemist, but a definite possibility through the application of modern science. Sir Frank Heath, secretary to the Department of Scientific and Industrial Research, mentioned some of the investigations which were being carried on by the Association, among which there was the jointing of non-ferrous metals, and he indicated that the research might result in the reduction by 5 per cent. in the expenditure on such jointing.

The Shipyard Dispute.

TRUE to their word, the shipbuilding employers posted notices of a national lock-out in all the Federated yards, to take effect yesterday unless the Southampton strikers returned to work on Tuesday. On Monday, at a mass meeting, the strikers rejected by an overwhelming majority a proposed method of settling the dispute, which had been arrived at by the National Executive Council of the Federation of Engineering and Shipbuilding Trades and the District Committee. Under this arrangement, the men were to return to work forthwith. Within twenty-four hours negotiations were to be begun at Southampton and were to be completed within two days. If the terms were not acceptable to the men, a ballot would be taken as to whether arbitration or a strike should be resorted to. The Executive Committee pledged itself to accept and act upon the result of the ballot. Out of a meeting of between three and four thousand, only about fifty men voted in favour of accepting this method of reaching a settlement. A trade union leader has suggested that the Communist influence behind the strike has utilised the psychology of the mass meeting to obtain a vote from the men adverse to their recognised leaders' advice. At any rate, following the mass rejection the dozen or so unions to which the men belong decided to ballot their members separately. In the ballot, the men were asked not only whether they would resume work on the terms proposed, but also whether they were for or against accepting the executive authority of their unions. Balloting took place on Tuesday among the 6000 or so men on strike. The result of that ballot did not show a majority in favour of resuming work, but equally it did not reveal a two-thirds majority in favour of continuing the strike. The executives of the unions involved accordingly ordered their Southampton members to resume work on Thursday morning. The shipbuilding employers, when the result of the ballot and the action taken thereon by the union executives, were reported to them, agreed to suspend the operation of the lock-out notices until the time of ceasing work to-day (Friday). This decision on the part of the employers applies to all the unions involved in the Southampton dispute except the Shipwrights' Society. That body has expelled its recalcitrant Southampton members, and accordingly the employers have withdrawn the lock-out notices in their entirety so far as the members of of this body elsewhere in the country are concerned.

Wireless at Sea.

IN our issue of March 21st we referred to some experiments which had been carried out in connection with calling devices which respond automatically to wireless distress signals at sea. It was stated that a report on the first series of tests showed that whilst a set designed by the Post Office was the most sensitive at long ranges, by far the greatest number of calls was obtained with an apparatus made by the Radio Communication Company. A report which has just been issued by the Marconi Company, however, throws new light upon the matter. It seems that the Post Office device gives far too many false calls, and it is understood that it is to be withdrawn from the trials. The Marconi instrument and that made by the Radio Communication Company have both given good results in the way of rejecting false calls. The Radio Communication Company's instrument has one more stage of amplification than the Marconi Company's set, and in consequence of this fact it has recorded the greatest number of calls. The Marconi Company points out that the range suggested by the Post Office was originally 75 miles, but in the experiments this range was ignored, ranges up to 170 miles having been adopted.

Proposed Plymouth-Belfast Air Service.

LAST autumn the de Havilland Aircraft Company carried out on behalf of the Government an extensive series of experiments on the transmission of mails by air from Plymouth to the North of England and across to Belfast. Although the results were in certain respects satisfactory, no steps were taken subsequently to establish a regular service. The Plymouth Chamber of Commerce has now taken up the matter for itself. Last week on its initiative a meeting was held in London between representatives of the Plymouth, London and Liverpool Chambers of Commerce, of the Air Ministry and of two aircraft companies. The meeting considered the question of establishing the service with or without the assistance of the Post Office and the Air Ministry. For the section of the scheme covering Plymouth to Liverpool, it had before it tenders submitted by the Aircraft Operating Company. For a once-a-day service each way, during 275 days in the year, this firm asked an annual payment of £16,500 on the assumption that D H 50 four-passenger machines would be used. The company said that it was willing, but not anxious to operate the service. Its estimate was based on a figure of £7 10s. as the cost of transporting a passenger over the whole distance, and on 7.2d. per pound of goods or mails carried. The meeting was unanimous in approving the scheme, and it is intended to submit it to another meeting at which representatives of Birmingham, Cardiff, Manchester and Belfast will be present.

Train Ferry for Nigeria.

LAST week there was launched at the Dumbarton yard of William Denny and Brothers a new paddle steamer train ferry which the firm has constructed for the Crown Agents for the Colonies. The vessel is 240ft. long, with three lines of rails laid on deck, and will be used on the Benue River ferry of the Nigerian Railways. On the bridge deck there is accommodation for the officers and a promenade for passengers, while waiting-rooms are provided on the main deck, provision for the crew being made below deck. The ends of the ship are specially shaped to fit a landing dock, and are furnished with hinged gangway platforms, so that rapid connection to the shore rails can be made. There are two independent sets of compound diagonal surface condensing engines, constructed by the builders of the ship, and by means of a clutch fitted on the paddle shaft, the engines may be made to operate simultaneously or independently. Steam is raised at 140 lb. pressure in four circular boilers of the Navy direct tube type. There are two rudders fitted, one at either end of the vessel, and steam and hand gears are provided whereby both rudders may be controlled simultaneously or the after rudder independently.

High-tension Transmission Lines.

By ERNEST V. PANNELL.

No. V.*

SECTION III.—SUPPORTS (*continued*)

Foundations.—As every possible kind of soil is encountered in line construction, so it is to be expected that a wide variety of tower foundations will be used. Probably the majority in use are simple ground stubs, consisting of a heavy angle bolted to the foot of each of the main tower posts and extending 7ft. or 8ft. into the ground, being bolted at its own foundation to a horizontal steel grillage of an area of 2 to 4 sq. ft., Fig. 21. The principal load to be withstood by this foundation is the uplift of the tension post, which may be in excess of 30,000 lb. Against this must be set the weight of the inverted frustrum of earth supported upon the grillage, which is usually calculated as being 100 lb. per cubic foot, and having a slope inclined 30 deg. with the vertical. In calculating the necessary area and depth of the grillage, it is usual to employ a safety factor of 2. As a matter of fact, however, when the footings are properly set and the ground is reasonably good and dry, the strength is much higher than that calculated, as an appreciable shear strength is present in earth which has had time to become bedded down. The tendency of the post members and the ground stubs to close up, owing to the horizontal reaction, must also be resisted by the earth, and hence the use of more elaborate anchors than those mentioned above is necessitated. Greater stiffness in the horizontal direction is provided by using a tripod or four-post tower post; its sole disadvantages are the somewhat greater difficulty of back-filling the excavation and the weight, which in the case of the Big Creek system in California amounts to nearly 25 per cent. of the entire tower steel.

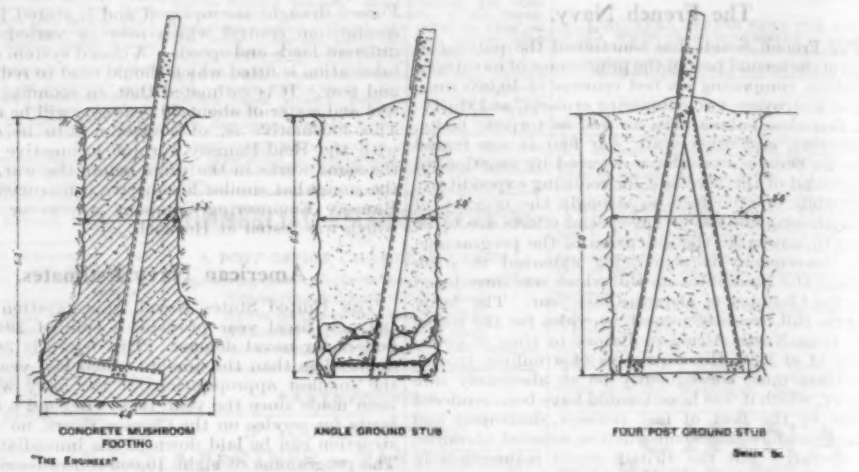

FIG. 21—EXAMPLES OF TRANSMISSION TOWER FOUNDATIONS

Other means have been adopted to resist the horizontal forces, and on one transmission line a completely braced panel was used below ground level. This practice has not been repeated, but one tower manufacturer makes a specialty of connecting the bottom tension diagonal to the main post about 4ft. or 5ft. below the ground surface instead of immediately above it. This arrangement is standard on the system of the Alabama Power Company, and also upon several lines in Japan, where ground conditions are generally not very good. Not only is the device effective in neutralising the tendency of the earth to yield and crack between the stubs, but it also forms a very cheap footing.

Concrete foundations are the most permanent and are almost invariably used for strain positions, where both the uplift and the horizontal forces are a maximum. There is also a tendency to employ concrete footings quite extensively for the standard towers as well where conditions permit. Generally, in desert and mountain regions, the most difficult item in construction is that of transporting the necessary material, and when both water and cement have to be added,

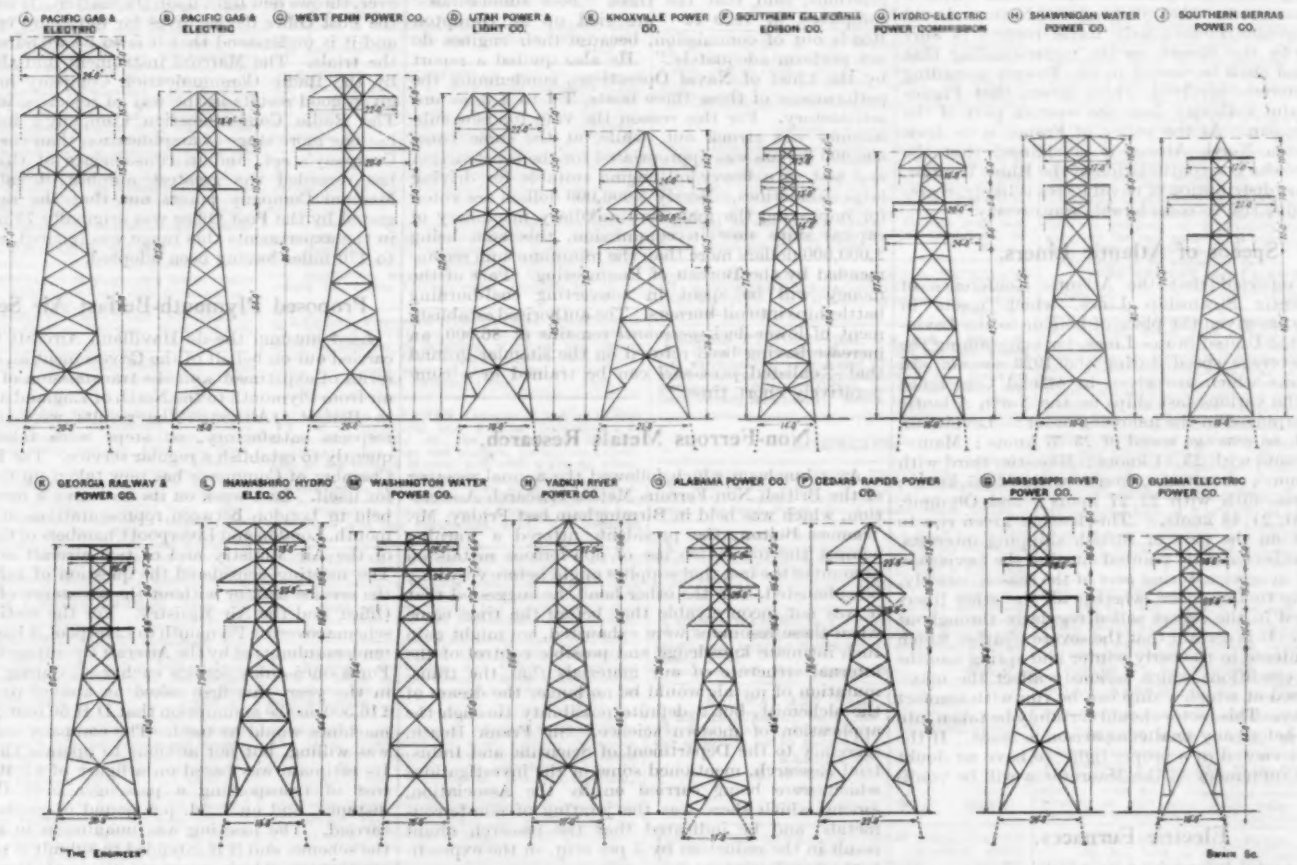
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FIG. 22—EXAMPLES OF TRANSMISSION LINE TOWERS

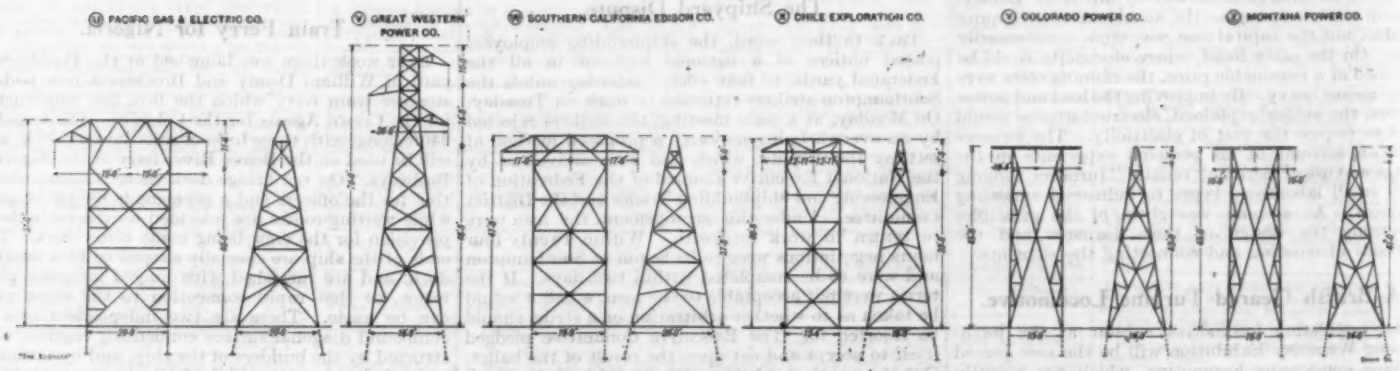

U PACIFIC GAS & ELECTRIC CO.
V GREAT WESTERN POWER CO.
W SOUTHERN CALIFORNIA EDISON CO.
X CHILE EXPLORATION CO.
Y COLORADO POWER CO.
Z MONTANA POWER CO.
"The Engineer"

FIG. 23—EXAMPLES OF TRANSMISSION LINE TOWERS

* No. IV. appeared April 4th.

the cost of construction increases very rapidly. In more favourable territory concrete can be readily mixed and placed, and its use at once reduces the amount of steel necessary for the foundations. On the other hand, a disadvantage is that the foundation gang must work about three days in advance of the tower party, in order that the anchors may be thoroughly set, and this spreads the work of construction over an undesirably wide territory. Furthermore, a very large number of forms will be required. The mushroom type of concrete anchor is much more primitive, but dispenses with forms entirely. It is made by digging a narrow hole about 6ft. deep, and expanding the bottom, either by a spoon or by the use of dynamite. The stub angle is then set and held in place by a template, while the concrete is poured into the excavation. This form of anchor is not only effective in withstanding a much greater uplift than the simple ground stub, but it is almost as cheap and easy to set. Great satisfaction has been experienced with this type of footing on the system of the Pennsylvania Water and Power Company, a line of heavy construction using double-circuit steel arm devised to minimise the risk of short circuit through "sleet jump." Generally, the greatest menace of sleet lies not in the load which it imposes on the wires, but in its uneven melting. A sudden release of a load of ice from one of the lower wires causes the conductor to whip vertically upwards, and possibly to make contact with the wire immediately above it. It is safe to say that many more failures have occurred owing to burn-offs from this cause than from actual mechanical overloading of the wires. The extended crossarm by no means affords a complete solution of the problem, and for districts where spans are to be long and sleet storms severe, no design will be as satisfactory as the single-circuit tower with wires disposed horizontally. Tying-in of the centre conductor—as shown in E and P—provides the same safeguard as the extension, but offers certain advantages. With very heavy conductors, the torsion load on the tower is considerably reduced if a crossarm can be shortened instead of extended. Widely extended ground wire supports—as at H—are no longer considered necessary; in fact, the ground wire is no longer considered indispensable. The submerged joint in the bottom panel—as seen at O and R—has already been described. It must be noted in passing that for the sake of consistency none but suspension towers have been illustrated. In general, the corresponding strain towers have the same outline, but are built with heavier angles, and are usually 4ft. to 6ft. shorter on account of the horizontal position of the strain insulators. Special structures for transposing circuits have not been shown, their difference from standard being only in the crossarms.

TABLE X.—*Data of Steel Transmission Towers (see Figs. 22 and 23).*

	System.	Kilo-volts.	Stand'd span.	Conductors.	Size.	[1]Tension per wire.	Ground wire.	Size.	[2]Tension per wire.	Weight. Stand'd.	Weight. Anchor.	Footings. Standard.	Footings. Anchor.	[4]Tests on standard tower. T., trans.; L., longitudinal; V., vertical.	Manufacturer.
	Double Circuit.				sq. in.	lb.		sq. in.	lb.	lb.	lb.			lb.	
A	Pacific Gas and Elec. Co.	220	800	6 copper	.393	6,300				8,038	12,334	Concrete	Concrete		Pac. Coast Steel
B	Pacific Gas and Elec. Co.	110	800	6 copper	.133	2,200	—	—	—	4,600	7,200	—	—	—	Pac. Coast Steel
C	West Penn. Power Co.	130	580	6 copper	.166	4,100	2 steel	.086	3180	8,500	12,000	Ground stub	Concrete	—	Blaw Knox Co.
D	Utah Power and Light	130	650	6 copper	.166	4,100	2 steel	.086	3180	5,166	9,989	Ground stub	Concrete	—	Milliken Bros.
E	Knoxville Power Co.	150	800	6 alum. stl.	[3].393	8,000	1 steel	.152	5600	12,900	14,200	Concrete	—	—	Am. Bridge
F	Southern Cal. Edison	66	700	6 copper	.166	3,650	—	—	—	4,511	7,881	Ground stub	Ground stub	3650 L., 1500 T.	Riter Conley
G	Ontario Hydro-Elec.	110	600	6 alum. stl.	[3].264	6,100	2 steel	.060	2200	5,400	—	Ground stub	Ground stub	—	Can. Bridge
H	Shawinigan W. and P.	110	520	6 alumin'm	.196	2,400	2 steel	.086	3180	4,800	6,200	Concrete	Concrete	15,000 L., breast pull	Can. Bridge
J	Southern Sierras Pr.	88	660	6 alum. stl.	[3].166	4,100	—	—	—	3,760	4,760	Various	Various	12,000 L., breast pull	Milliken Bros.
K	Georgia Ry. and Light Co.	110	620	6 copper	.166	4,100	2 steel	.115	4200	5,554	6,880	Ground stub	Concrete	8000 L., 10,000 T.	Am. Bridge
L	Inawashiro Power Co.	110	550	6 copper	.157	3,900	2 steel	.086	3180	6,780	12,760	Various	Concrete	3000 L., 14,000 T., 13,000 V.	Am. Bridge
M	Washington W.P. Co.	60	750	6 alumin'm	.132	1,660	1 steel	.086	3180	6,000	—	—	—	9000 L., 4000 T., 4000 V.	Am. Windmill
N	Yadkin River Power	100	700	6 copper	.083	2,100	1 steel	.086	3180	3,111	—	Ground stub	Ground stub	10,000 L., breast pull	Milliken Bros.
O	Alabama Power Co.	110	600	6 copper	.105	2,600	2 steel	.086	3180	4,800	—	Ground stub	Ground stub	7000 L., 5000 T., 1200 V.	Am. Bridge
P	Cedars Rapids Mfg.	110	660	6 alum. stl.	[3].393	8,500	1 steel	.152	5600	7,000	—	—	—	—	Blaw Knox
Q	Mississippi R. Power	110	700	6 copper	.238	5,900	2 steel	.152	5600	6,800	10,500	Concrete	Concrete	—	Riter Conley
R	Gumma Elec. Power	110	600	6 copper	.166	4,100	1 steel	.086	3180	5,620	9,800	Concrete	Concrete	—	Watanabe
	Single Circuit.														
U	Pacific Gas and Elec. Co.	220	800	3 alum. stl.	[3].406	—	—	—	—	5,043	7,631	Concrete	Concrete	—	Pac. Coast Steel
V	Great Western Power	165	700	3 alum. stl.	[3].272	7,900	—	—	—	—	—	—	—	—	Pacific Coast
W	Southern Cal. Edison	150	660	3 alum. stl.	[3].475	10,000	1 steel	.150	5600	5,600	8,050	Ground stub	—	8300 L., 1700 T., 2500 V.	Milliken Bros.
X	Chile Exploration Co.	110	660	3 copper	.132	3,300	2 steel	.086	3180	3,360	5,400	Ground stub	Concrete	6700 L., 4600 T., 3000 V.	Am. Bridge
Y	Colorado Power Co.	90	750	3 copper	.083	2,100	—	—	—	2,200	—	Various	Various	—	Riter Conley
Z	Montana Power Co.	100	600	3 copper	.083	2,100	2 steel	.086	3180	2,140	—	—	—	—	Am. Bridge

NOTES.—[1] Maximum based on elastic limit. [2] Based on one-half elastic limit. [3] Aluminium area only. [4] Test loads represent the sum of those applied at different insulator supports.

towers. The maximum strength of the footing was never determined, but in field tests it failed to show any signs of distress with 70,000 lb. uplift.

In general, in every transmission system there will be a number of places in which concrete foundations are necessary, and it might be expedient and good practice to extend the use of concrete to all the footings in a given territory.

Survey of Modern Practice.—The tower designs illustrated in Figs. 22 and 23 represent the most recent practice in this direction. Design A is the first double-circuit tower to be built for 220-kilovolt operation,

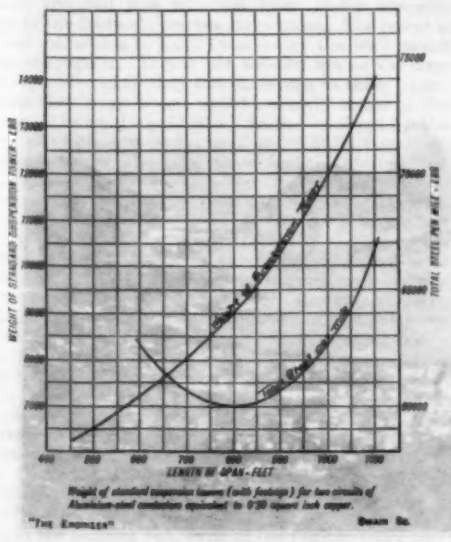


FIG. 24

and illustrates the spacings required in contrast to B, which is the standard 110-kilovolt tower on the same system. Actually, the extra distances for the higher voltage are not of great significance, and although the A design is much heavier than B, this is a function of the greater area of the conductor wires than of the extra measurements. The construction illustrated at D shows the use of "umbrella" type or underhung crossarms to maintain clearances with the maximum swing of insulators. Actual swings of 60 deg. have been reported on this line, although in most instances 45 deg. is the design assumption. C and other designs exhibit the offset middle cross-

Obviously, the single circuit designs are more nearly ideal from the structural view-point. The horizontal spacing of conductors is also advantageous, both for construction and maintenance, and where the necessary right of way can be secured at low cost, two towers of this type are far preferable to a line of double-circuit structures.

Fig. 24 is interesting as showing the relations between the length of span and (*a*) the weight of standard suspension towers, and (*b*) the total weight of steel per mile, when using two circuits of aluminium steel conductors equivalent to 0.20 sq. in. copper.

Obituary.

WILLIAM INGHAM.

THE engineering profession has experienced a heavy loss by the death from heart failure, at the age of fifty-six, of Mr. William Ingham, which took place at Johannesburg on March 7th last.

Mr. Ingham, as our readers are aware, had for the last fourteen years or so held the position of Chief Engineer to the Rand Water Board; but he had done excellent work in other parts of South Africa for some seven years before being appointed to that post, and, before leaving this country, he had already given evidence that he was the possessor of engineering ability far in excess of the ordinary.

Mr. Ingham began his business life by being articled to to Mr. J. E. Stafford, a civil engineer of Burnley, Lancs., and when about twenty-three years of age he was appointed assistant to Mr. Edward Sandeman, who was then waterworks engineer to the Plymouth Corporation. At that time the famous Burrator Reservoir Works were in course of construction, and during part of his five years' sojourn at Plymouth Ingham was second engineer at those works. He did not, however, remain for the completion of the Burrator Dam, the last stone of which was laid with old-time ceremony in the autumn of 1898, for two years previously he had been offered and accepted the position of water engineer of Torquay, in succession to the late Mr. Thomas S. Weeks. While in charge at Torquay he designed the works for the formation of the Trenchford Reservoir, and carried out a large proportion of them, though, as with the Burrator Reservoir, he did not see their termination, for in 1903, when but thirty-five years of age, he was made hydraulic engineer to the municipality of Port Elizabeth in South Africa.

The new waterworks at Port Elizabeth were of an extensive and important character, and were so successfully carried out by Mr. Ingham that he became in a short space of time one of the busiest consulting engineers in the whole of South Africa. His advice was sought on numerous subjects, including sewerage, water supply and irrigation, by many South African municipalities and commercial undertakings, and he gained particular distinction in connection with various irrigation enterprises. He is described as being a firm believer in the conservation of water, irrigation and afforestation, and considered an energetic policy in these matters was essential to the progress of the Union. Among his irrigation triumphs may be cited his work on the Movene Estates not far from Lorenço Marques, which embraced an area of 70,000 acres, and the Britstown Reservoir, which he designed and constructed for the Smartt Syndicate. The latter has a surface area of some 10 square miles, and furnishes water for irrigating 9000 acres. Then, again, he carried out in the Zebediela Estates of the African Realty Trust, an irrigation scheme for dealing with 9 square miles, the necessary works entailing an expenditure of a quarter of a million of money. Then, too, there was a project on the Crocodile River which concerned 10,000 acres.

It was doubtless the success which attended these and other works that were carried out to the designs of Mr. Ingham which determined the Rand Water Board to choose him as their engineer in 1910. There were, we believe, 168 applicants for the post, and many of them were engineers of high repute in countries other than South Africa. It is said that the Board had no difficulty in deciding that he was the foremost among South African engineers of the time in his own particular sphere, but among those who had entered the contest from overseas were many who possessed undoubted qualifications of exactly the required character. However, the choice eventually fell on the engineer with the local knowledge, and the Board never once had occasion to regret its choice. He managed the engineering department of the undertaking in masterly fashion and with admirable foresight.

It would be impossible here to refer to all the work that he did, but of his latest achievement, which also was probably his greatest, something must be said. We refer, of course, to the Vaal River Barrage which Mr. Ingham had the satisfaction of living to see completed and the utility of which was so much in evidence during the late drought. The barrage was so fully described in Mr. Ingham's own language in our issue of Dec. 1st, 1922, that it is not necessary to refer to it at any length in the present instance, the more so that only last week, and when we were still unaware of his death, we reprinted his description of the sluices in connection with a model of one of them which has been made by the builders for exhibition at Wembley. It can be said, however, that before deciding upon the Vaal River as the source of additional supplies for the Rand, Mr. Ingham investigated no fewer than 26 different schemes for impounding water within a radius of 50 miles from Johannesburg, and he explored the Vaal River itself for 180 miles before he was satisfied as to the best position in which to erect the barrage. A peculiar feature of the scheme is that the water is drawn from the

reservoir not, as might be imagined, at or near the barrage itself, but at a point some 23 miles higher up the river. By arranging matters so that the pumping station could be built where it is, two important advantages were obtained. First it was near a railway station and, consequently, within easy reach of collieries; and, secondly, there was a saving of some £200,000 in pipe lines.

We transcribe the following from the issue of March 8th last of the Johannesburg *Star*, to which, also, we owe indebtedness for much of the information contained in the foregoing:—"Mr. Ingham's name is popularly associated with the Vaal River barrage at Vereeniging, but notable achievement as that was, it is within the ranks of his own profession that his outstanding ability, his amazing energy and his lifelong devotion to the highest standards of duty were completely recognised. This in itself is a remarkable tribute to a remarkable man. By common consent the civil engineers in South Africa looked to Mr. Ingham as a leader, and not merely as a leader of ability and experience, but as one whose transparent honesty of purpose and whose gifts of character dignified his profession . . . In his profession he was never known to acknowledge defeat. From first to last he was a fighter against every difficulty presented to the engineer. . . . . Whether working with him or under his direction, all his fellow workers came on a real affection for him. He set high standards for all to conform to, but away from his work he was 'all heart' as a colleague said of him to-day. In him the 'lame dog' and the engineer in a difficulty had an unfailing friend."

Mr. Ingham became an associate member of the Institution of Civil Engineers in 1895, and was transferred to the class of member in 1908. He had been a member of the Institution of Mechanical Engineers since 1898. He was president of the South African Society of Civil Engineers and of the S.A. Institution of Engineers. He had been vice-president of the S.A. Association for the Advancement of Science, and president of the section concerned with his work own. He was chairman for five years of the S.A. Branch of the Institution of Municipal and County Engineers. In him we ourselves have lost one who from time to time—though all too rarely of recent years as the calls of his business became heavier and heavier—sent us valuable contributions on various subjects.

The Resaca of Rio de Janeiro.

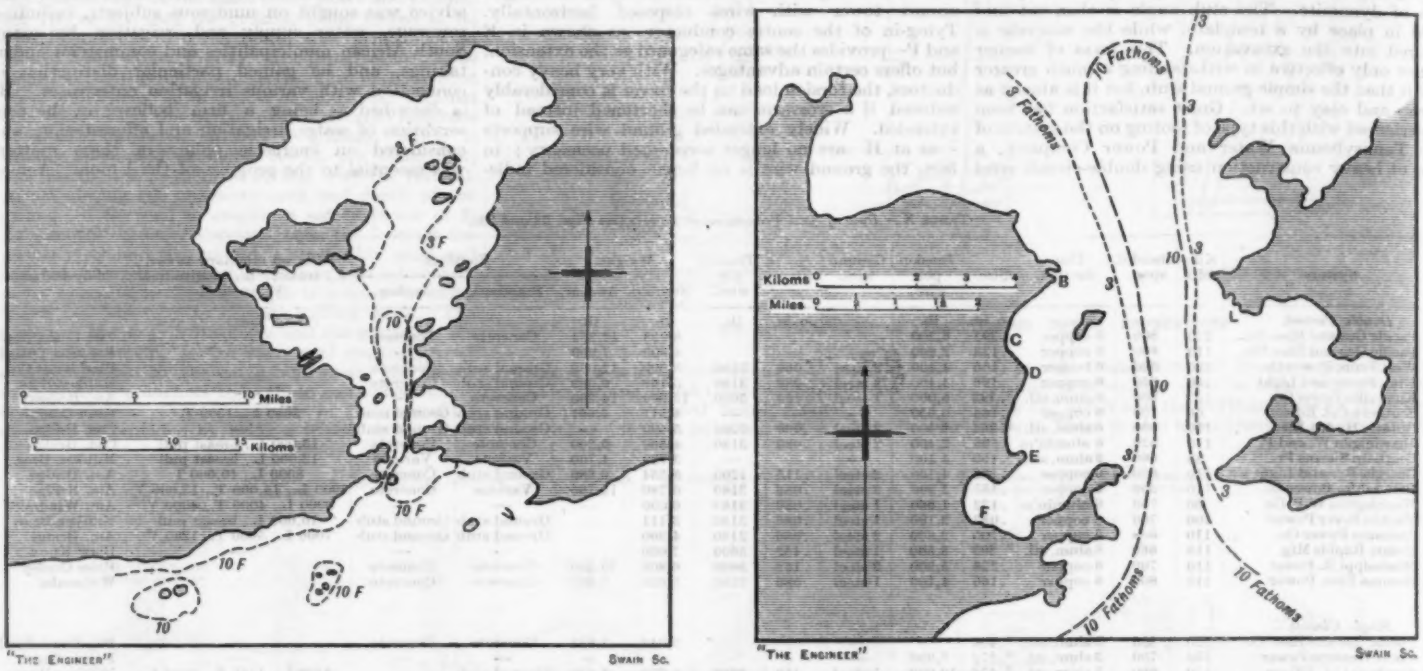
By REGINALD RYVES, F.R. Met. Soc.

THE great wave storms, locally called "Resacas," which occasionally visit the Bay of Rio de Janeiro and the adjacent coasts, differ entirely in character from storms produced by local winds, and attack the shores in a different and sometimes much more effective manner. On a calm and sunny day there is something eerie in the silent advance of these long swells upon the wall-protected boulevards, which have been made on reclaimed ground. "The sea," say the "fluminenses," "is determined to regain its stolen shallows, and sooner or later will do so." The absence of any evidence of stormy conditions during some of these resacas has led to the idea that they are caused by movements of the bed of the sea; but such movements, although they no doubt produce the great waves which the daily Press calls "tidal," can hardly be the cause of a series of waves of about the same height and length, lasting for several days.

The so-called "bay" of Rio de Janeiro, which is really a gulf with a narrow entrance, is situated on that part of the South American coast which runs nearly east and west, and the entrance to the gulf faces nearly south by east. A glance at a map of the Southern Hemisphere will show that there is in the South Atlantic a very great area of ocean in which storms may develop their full intensity, uninterrupted by land or shallow water. The greatest wind velocity being produced in the south-west segment of a cyclone moving north-west, or in the western segment of a cyclone moving north, the conditions are very favourable for the production of large waves travelling towards the bend in the coast of South America, and the expanse of ocean is great enough for such waves to attain their maximum size and velocity. The observations recorded by Dr. Vaughan-Cornish in his book, "Waves of the Sea," show that the South Atlantic produces waves as large as any which have been met with in other oceans. In one storm many of the waves were from 38ft. to 45ft. from trough to crest, and the largest was computed to be 50ft. A procession of great waves travels far beyond the range of the storm that produces it, and, even when it has died down to long, low swells, possesses a large amount of energy.

Wave storms have been attributed to the accumulative effect of a distant cyclonic storm lasting for several days without moving. It seems likely, however, that the greatest wave storms are the result of the effects of travelling cyclones, the waves formed in the sector in which the direction of the wind is the same as the direction of travel of the cyclone being then under sustained wind for a large part of their journey. Such waves, travelling on after the storm had died down or ceased to travel, may arrive at the coast on a windless day. If there is a wind which produces local waves, the latter may act independently, or they may intensify the onslaught of the long swells and alter for the worse the nature of the attack upon the shores.

In Rio bay—see Figs. 1 and 2—the waves have only a narrow passage, little more than a mile in width, by which to enter. In view of the remarkable effects produced, it is worth while to note the shape of the bay in two respects. First, its capacity to receive the great waves; and, secondly, the positions and distances of the shores on which the waves produce their high-leaping effects or exhibit their destructive forces. As regards the first point, if the waves come from south by east, the most favourable case, there lies before them in their line of advance a deep-water channel of 10 fathoms and more, about 6 miles long, and widening very gradually from a width of ¼ mile, near the entrance, to about 1¼ mile towards the far end. The 3-fathom limit, enveloping this deeper water, forms a similarly shaped funnel, about ¾ mile wide, near the entrance, widening out very gradually to about 2¼ miles just beyond the end of the 10-fathom channel, and extending for about 6 miles further, with an average width of about 3 miles—see Fig. 1. The area in which the shore effects of the waves are most marked is that between the entrance and the points B and L—Fig. 2—and the waves can therefore travel unimpeded through this area to the wide part of the bay beyond. As regards the second consideration, respecting the shape of the bay, the shore C B is 1¼ mile from the deep-water channel, and E D 1¼ mile, while the inner bay of



FIGS. 1 AND 2—SKETCH PLANS OF THE BAY OF RIO DE JANEIRO

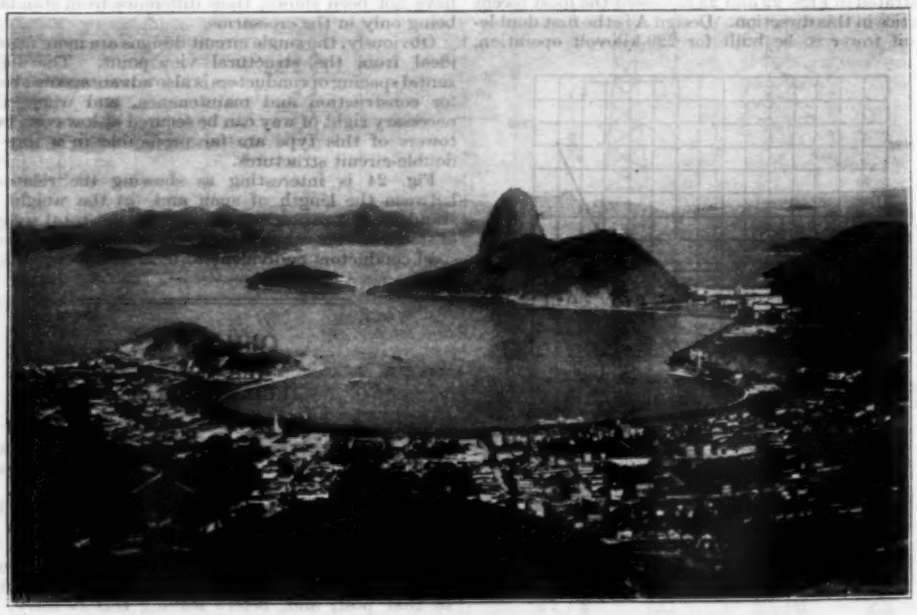


FIG. 3—GENERAL VIEW OF THE BOTOFOGO BAY

Botofogo, shown at F, Fig. 2, is about 2¼ miles distant. Now, the fanning out of the waves is so complete that those approaching those shores are parallel to them; that is, the waves approaching E D or C B will be quite parallel to a part of it, in each case, while the waves in the bay F fan out so completely that they become parallel to the shore at all points. In the case of C B, this involves changes in the direction of travel, varying from 60 deg. to 70 deg.; in the case of E D, 80 deg. to 90 deg.; while in F the change has been, first through about 100 deg., with a further secondary fanning out to about 90 deg. each way. The shores are protected by a granite wall and parapet, the wall being about 10ft. to 12ft. high from the beach to the roadway level, and surmounted by a 3ft. granite parapet built up of posts, panels and coping stones. The foot of the wall is in some parts at about low-water level, elsewhere about 2ft. or 3ft. lower. The upper part of the wall is vertical; the lower part slightly battered. The batter is not increased at the foot of the wall, and the face disappears into the beach without any curve. The extreme measured range of spring tides is little more than 4ft., but the depth of water may be slightly increased during a storm, especially with a south wind.

Under these conditions, the height to which the waves leap vertically on striking the wall is remarkable. Some of the waves are shown in the views on page 388. Not every wave leaps thus, since the shallowness of the water and the position of the retiring water of the previous wave combine in many cases to alter the nature of the advancing wave, so that it breaks or churns up or crashes against the wall without leaping. The waves that reach the wall without such interference leap to great heights, often 60ft. or 70ft., and sometimes to 100ft. The leap does not consist in the throwing up of spray, for the wall of water is continuous throughout its height. The wave rears up, and the water, though shattered to several times its bulk, stands up as a wall, and then, on windless days, falls vertically just outside the parapet, only a small portion falling on to the parapet and footway. In Botofogo Bay, the waves do not leap to such great heights, but the effects are not less remarkable, having regard to the position of this small bay in relation to the deep-water channel. The heights of the waves approaching E D and C B, judged by the eye, seem to be seldom as much as 5ft., but the wave lengths are very great in proportion to the heights.

Within the bay the damage done by a resaca without wind is small, but the shore promenade and roadway of an Atlantic coast suburb suffer considerably. The case is greatly altered within the bay when the resaca is accompanied by an on-shore wind. The difference was shown in a very marked way in 1922. Not long after a windless resaca had visited the bay, doing little damage, another resaca, accompanied by a wind which was on-shore at the portions of the wall E D and C B, was experienced. In this case, the waves did not rise vertically, but took high leaps over the parapet, flooding the roadway. The blows delivered against the wall were also far more powerful, and long granite coping stones and panels of the parapet were hurled 30ft. or so across the roadway, some of these pieces weighing about ¾ ton. Breaches were made in the wall, and in other places the soil was removed from under concrete flags of the footway, leaving large holes. The removal of the soil seems to have been under the wall rather than through it. It was not washed up, as the flags did not move until they fell in, except in those places where they were blown up at an early stage of the storm. The local wind had a "fetch" of about 3 miles from the opposite shore, or 2 miles from the deep-water channel. The local waves had therefore only a short distance to travel before reaching the swells moving at right angles to their direction of travel, and they had a very short distance to travel after their direction nearly coincided with that of the diverging swells. Yet the effect of the quite moderate local wind and waves in changing the leaping action of the long swells into an attack of great destructive force was very marked. No explanation of the relations between the two sets of waves is here attempted; but the facts, as outlined, may be of interest to those who have closely studied wave action.

To sum up, the interest of these wave storms lies in the following points:—The remoteness of the storms producing them, of which no sign could be observed in Rio; the narrowness of the entrance to the gulf, compared with the width immediately inside; the narrowness of the deep-water channel, which forms a fairway for the waves; the completeness of the fanning out, even in the remote inner bay of Botofogo; the distance of the damaged parts of the wall from the deep-water channel, and the shallowness of the intervening water; the shallowness of the water at the foot of the wall hardly anywhere attaining 7ft. at high tide; the completeness, in the case of a windless resaca, of the conversion of an undulation into a vertical leap, without any curve to help it; and the change to destructive effects when the resaca was seconded by a moderate local wind.

THE South African Minister of Railways has appointed a Commission of Inquiry to investigate the question of the foundations of the Durban grain elevator.

Institution of Naval Architects.

No. I.

THE annual meetings of the Institution of Naval Architects opened at the Royal United Service Institution on April 9th, under the presidency of the Duke of Northumberland.

The annual report of the Council was presented. From it we learn that the membership continues to increase at a satisfactory rate, the total now approaching 3000. The special fund for research work at the William Froude Tank received during the year £620 in contributions from shipbuilding firms and registration societies, and £1000 from the Chamber of Shipping. The research work yielded valuable results, and it is hoped that shipbuilding firms will continue to give their generous support to the research fund. Two Premiums were awarded for papers contributed to the "Transactions" in 1923; one to Mr. A. M. Schippers, of Rotterdam, for his paper "Dutch River Lighters," and the other to Mr. John Anderson, of Greenock, for his paper "Influence of Form upon the Stability and Propulsion of Passenger Ships." The Council has had under consideration a scheme for awarding in association with the Worshipful Company of Shipwrights certificates in naval architecture to students at various secondary schools. A deputation was received by the Board of Education, which expressed its readiness to consider a scheme, and a committee has been formed jointly with representatives of the Shipwrights' Company to prepare a suitable scheme. The William Froude Tank Advisory Committee having called attention to the need of a new set of experiments, similar to those on H.M.S. Greyhound—see "Transactions," I.N.A., 1874—the Council has formed a committee representing the principal experimental tanks in the United Kingdom to prepare a scheme. Sir Richard Glazebrook, C.B., D.Sc., F.R.S., has kindly consented to act as chairman of this committee. The other members of the committee are:—

Admiralty (Haslar Tank)	Mr. M. P. PAYNE, Mr. C. M. CARTER.
National Physical Laboratory (William Froude Tank)	Mr. G. S. BAKER, O.B.E.
Messrs. John Brown and Co. ..	Mr. W. J. LUKE, C.B.E.
Messrs. William Denny Bros. ..	Mr. E. R. MUMFORD.
Messrs. Parsons' Marine Steam Turbine Company	Mr. T. G. POTTS.
Messrs. Vickers	Mr. H. MUNDEY.

The election of President, officers, and Council, resulted in the re-election of the Duke of Northumberland as President and the re-election of the existing Vice-presidents. The ballot for new members of Council resulted in the election of the following members:—Professor T. B. Abell, Mr. A. J. Campbell, Mr. W. E. Denny, Sir Frederick Henderson, Sir Alexander M. Kennedy, Mr. D. B. Morrison, Mr. R. L. Scott, Mr. John Smith, Sir John E. Thornycroft and Mr. R. J. Walker. The following were elected associate members of Council:—Sir Kenneth Anderson, Sir Alfred A. Booth, and Vice-Admiral Sir Roger Keyes.

The President announced that premiums for papers contributed to the "Transactions" of the Institution had been presented to Mr. A. M. Schippers, of Rotterdam, for his paper on "Dutch River Lighters," and to Mr. John Anderson for his paper on "Influence of Form upon the Stability and Propulsion of Passenger Ships."

The Duke of Northumberland, in a brief opening address, referred to the increase in the membership of the Institution—a fact which is regarded as extremely gratifying considering the severe depression through which the shipbuilding industry is passing. It had been decided, he said, to hold a summer meeting in London, when it was hoped to make some return for the hospitality given to members of the Institution during their visits to Holland and France. The meetings which had taken place on the Continent had undoubtedly added to the prestige of the Institution as an international body. It was an unfortunate fact that whenever the Institution held its spring meeting it coincided with labour troubles in the shipyards, and the present meeting was no exception to that rule. It was, however, satisfactory to know that all parties in the State were now fully alive to the disastrous effect of these recurring strikes, and the best brains of the country were now engaged in the task of finding some means of preventing the use of the strike weapon. He hoped they might be able to look forward to a period of industrial peace, lacking which it was impossible to expect any real revival in trade and industry. Although there were not many reasons for optimism in connection with the present position, there were some indications of an improving situation. First, some progress had been made in settling the question of reparation; and, secondly, it should be realised that at the Imperial Conference last year agreement was reached in connection with lines of policy destined to bring about a closer co-operation in trade between the different Dominions of the British Empire. He hoped they saw in these two facts the foundation for a revival in continental trade, and also for the building up of a better system of trade within the confines of the Empire.

Admiral Sir Doveton Sturdee, who was warmly received, then presented a paper dealing with the "Strategical and Tactical Considerations Governing Warship Design." We give below an abridgement of it.

WARSHIP DESIGN.

The well-recognised strength of the British Navy from 1815 until 1914 was a great asset in the preservation of the world peace, and ensured for this country naval peace for a century. This superiority we have, with our eyes open, abandoned in so far as battleships and aircraft carriers are concerned; therefore, strategically, we have placed ourselves at a disadvantage with any great Power that has an equal force of battleships, particularly if that Power is a continental nation and is self-contained, while we, with our communications to our Overseas Dominions, have some 80,000 miles of ocean routes to defend.

All indications seem to show that the gun will continue to maintain its pre-eminence over all other weapons of offence. It will continue to defeat at effective range any armour which it is possible to carry. Effective means have been devised to reduce ships' vulnerability from torpedo explosions, but to ensure protection from mines, external methods for sweeping mines from the path of the ship are still necessary; the paravane may not prove sufficient. Can means be adopted in the design to prevent heavy poisonous gases finding their way into the lower compartments of a ship? Might not the adoption of internal combustion engines be one solution for reducing this source of trouble?

With aircraft spotting, the gun range will be further increased, rendering protection from plunging fire still more imperative. It is hoped that more thought is being given to the protection of the magazines from the flash from exploding shell and to more effectively breaking direct communication with the magazine. Let us hope that, with the chances of peace during the next century not being so rosy as in the previous hundred years, ships will be designed for one object, viz., to be most highly efficient for battle, all other thought being subservient to that one end. Rapidity of fire for competition in peace practice should never again be allowed to vitiate their efficiency for action with an equal or superior opponent. Experience in the war showed that bulges were very effective. They should be included in the design of all battleships and embodied so far as practicable in other classes. The increased safety obtained by having complete water-tight bulkheads, unpierced by doors, was fully demonstrated.

In accordance with the Washington Agreement, there will be no class of ship except the aircraft carrier between the 35,000-ton battleship, with its 16in. guns and the 10,000-ton cruiser with its 8in. guns. No limit of number has been assigned for the cruisers. They may become the most important class of ship; therefore too much attention cannot be given to their design. The late war only emphasised our previous war experience—the great need of cruisers and the varied services that they were called on to fill, such as to accompany battle fleets or squadrons, convoying duties, protection of trade routes, foreign stations, anti-submarine duties, &c.

The requirements for a British cruiser may be briefly summarised as follows:—

(1) Sea-keeping is probably the most important; also to carry the guns at such a height and manner that they can be used effectively in most weathers. The Battle of Coronel gave us a most painful experience, because this necessity had not been realised in some of our cruiser designs of the past.

(2) Steadiness of platform becomes of increasing importance with the increase of gun range.

(3) A good radius of action is essential.

(4) A higher maximum speed than that of possible enemy battleships.

(5) Good offensive power.

(6) Vertical armour must be sacrificed in order to obtain as much horizontal armour as possible over the vital parts and gun positions.

(7) Submerged torpedo tubes probably not being possible on such a limited tonnage, armoured above-water tubes may be fitted in cruisers designed to accompany a fleet, but for other cruisers this weight might better be utilised.

(8) Each cruiser should carry and be able to launch two aeroplanes.

(9) Anti-air defence guns, particularly for cruisers intended to accompany battle fleets.

Battle fleets will no doubt have one or more aircraft carriers with them; therefore, the latter will require to have a speed equal to that of the fleet. Their large size should render them seaworthy.

Destroyers will be largely required for ocean work; therefore, ocean-keeping qualities will be essential. This will mean some increase in size, more attention being paid to the position and construction of the bridge. The number of times, even in North Sea waters, that either the fleet had to ease speed or the destroyers had to be detached, showed a need for better sea-going qualities. Possibly, in order to obtain these requirements in destroyers, they may become nearly as large as the present destroyer leaders.

Before considering the design or size of submarines, it would be wise to consider the policy we are going to adopt. Should we lead in the increase of size and power or follow other nations? Is it our best policy to force the pace or await what other nations do? Is it not our true policy to follow, but not to lead, in this type of ship, but in the meantime not to neglect any opportunity to ensure that our war anchorages and ships are safe from their menace? If, however, other nations are determined to construct larger and more formidable submarines, we must reply to this threat to our internal communications by building similar vessels. This will mean submarine cruisers—a type of vessel that requires deep water to operate in, and therefore suitable for ocean warfare.

The introduction of ocean submarines will necessitate some special form of submarine hunter—cruisers of superior gunfire to that of the submarine. The comparatively short-range guns our convoying cruisers were armed with in the late war will not now be sufficient.

To ensure the mobility of our ships, there must be ample docking facilities suitably placed on our main trade routes. The well-known loss of speed and excess of fuel expenditure, due to a foul bottom through lack of frequent cleaning, is another reason for these docking facilities. With the introduction of oil instead of coal, supplying ships at sea with fuel will be a future possibility. Oilers suitable for this purpose should be provided.

The late war showed that, so long as ships were under way, air attack is not serious, and there seems no reason to modify this experience. However, defence from the air is essential for ships assembled at a base within air-striking distance of an enemy.

Sir Philip Watts, who opened the discussion, said that there could be no questioning the statement of the author that sub-surface vessels or aircraft, or the two combined, could not replace surface vessels at the present time, whatever the future might bring forth in connection with naval armament. There could be no doubt that the superior strength of the British Navy for the last hundred years had had a tremendous effect in the preservation of the peace of the world. This superiority we were, with eyes open, abandoning as fast as possible, and a position would be reached when we should in some respects be weaker than any other great naval Power and be

unable to afford adequate protection to the outlying parts of the Empire. With regard to the need of designing British warships to resist the effects of torpedo explosion and of bombs, it was obvious that warship designers must provide for the almost certain advance in the offensive power of both submarines and aircraft. All the points mentioned by Sir Doveton Sturdee in connection with vulnerability were most important. On the subject of aircraft carriers, the author had laid stress on steadiness of platform and a good clear deck for flying off and landing. He—Sir Philip—remembered that in modifying H.M.S. Furious to convert her into an aircraft carrier, a proposal was submitted by Sir W. G. Armstrong, Whitworth and Co. for telescopic funnels on the side of the vessel and telescopic masts for carrying the wireless aerial and using elevators for the conning towers with the object of obtaining a perfectly clear deck for the full length of the ship. For some reason that proposal was not approved. He was in disagreement with the author on the subject of bulges. The pre-Dreadnought battleships and cruisers had insufficient stability, and a number of vessels were lost from both gunfire and torpedo attack causing the flooding of a single large compartment. The "Dreadnought" class was designed with sufficient stability to be reasonably safe against the flooding of compartments, and that observation applied to all vessels down to and including the Queen Elizabeth, and was also true of three ships of the "Royal Sovereign" class to which bulges had been added. In the "Royal Sovereign" class there was unfortunately a return of the old method of reducing stability with the object of obtaining a steadier gun platform, and bulges were added to correct want of stability. There was no material advantage in adding bulges to a new ship, and it was understood that the new capital ships now under construction would not be fitted with bulges. It was, of course, essential that warships should have sufficient stability to remain upright as long as possible, as additional compartments were flooded, consistent with other requirements, as while all possible protection against injury should be provided there must come a time when the protection would fail and only reserve of stability could save the ship. There were various ways of making a ship a steady gun platform without reducing the stability to a dangerous degree. Bilge keels were commonly used; anti-rolling tanks were fitted in the old Inflexible, and in several vessels built afterwards, while gyroscopes were now being employed in a very practical form.

Admiral Clifton Browne said that great stress had been laid on the need for steadiness of gun platform, and from the gunnery point of view it was the most valuable asset in a fighting ship. The controversy as to whether and to what extent stability should be sacrificed to obtain a steady gun platform must be fought out by naval constructors. With regard to vulnerability from torpedo explosion or mine attack, naval officers had a high opinion of paravanes and their design would doubtless be improved. The bulge was no doubt an effective means of obtaining greater safety for a warship, and that and other means of defence would doubtless advance with equal ratio with methods of attack. In connection with the proposal to build a number of cruisers up to the maximum of 10,000 tons displacement, the size of such vessels would make them rather vulnerable to underwater attacks, and it would be necessary to provide destroyers to protect the cruisers. His own view was that it would be a sounder policy to build smaller cruisers for the protection of merchant ships engaged in overseas trade, and to limit the number of large cruisers. On the subject of aircraft carriers, it seemed obvious that the comparatively low speed of those vessels would hamper the movements of the fleet. He agreed that the surface warship must persist, and that with the requisite number of cruisers and destroyers and other auxiliary aids the submarine would be kept in check.

Mr. W. J. Berry, Chief Director of Naval Construction, said that the Institution was very fortunate to have had the paper from Sir Doveton Sturdee. It was the first occasion on which an Admiral who had actually taken British warships through a victorious battle had communicated his opinions and reflections to the Institution. There was a wealth of detail in the paper, which clearly indicated the nature of the post-war problems in design. The points set out in detail all had an effect of modifying pre-war views and the conclusions arrived at in peace time as the result of fleet manœuvres, target practices, &c. The extreme ranges at which gunfire was effective in the war and the development of bomb dropping from aeroplanes had modified opinions on the subject of deck protection, while the progress made in torpedoes and the danger of near misses from heavy bombs had necessitated a reconsideration of the underwater protection of warships. There was the further requirement that in future British ships of all classes must be made suitable for action on the ocean, possibly far from their base. The limitation of displacement brought about by the Washington Agreement had also become an important factor in increasing the difficulty of producing satisfactory designs. The experience of the war had been the subject of close, continuous study by the Admiralty Naval Staff and the technical departments, and, following this, a great amount of research and experiment had been conducted by the Admiralty, new arrangements being first tried on a reduced scale of size, these experiments being followed up by full-size experiments where necessary. These had inevitably taken time and had involved the expenditure of a considerable amount of money, but by the knowledge so obtained arrangements had been adopted in the latest ships with a view of making them safe against any known attack. In the past it had been the general case that the technical staff at the Admiralty had been fully engaged on current work, and indeed overburdened; time for thought about new developments had been exceedingly difficult to obtain. The author of the paper, whose experience made his opinion of the utmost importance, considered that the gun would continue to maintain its pre-eminence over all other weapons of offence. He fully shared that opinion. At present the gun was the only weapon of precision, on account of its high velocity and the possibility of accurate control. It was believed that armour and deck protection had been provided which would effectually protect the vitals of the ship when fighting took place at the ranges which became usual in the last war. This belief was based on a comprehensive series of full-size experiments. Deck protection, which was effective against shell attack, would be effective against bomb attack. The latter, it must be remembered, was essentially an attack of comparatively low velocity, although there was the possibility of very large charges being dropped on the ship from aeroplanes. The question of anti-flash arrangements to magazines was taken up during the war, and the provision against flash enormously improved, and the matter had received close attention in the latest designs. It had to be remembered that safety arrangements of this nature on too elaborate a scale must inevitably tend to make efficient, rapid supply of ammunition a matter of great difficulty. If too many checks and safeguards were interposed, the failure of any one of which would stop the chain of supply, the whole object of the armament, which was to fire and to fire rapidly, would be defeated. The question of vulnerability to poison gases had been studied very closely, much experimental work was in progress, and the results already obtained were very promising. Of course, a boiler-room required such an enormous quantity of air for the boilers that protective measures other than gas-masks were impracticable. Internal combustion engines also needed a supply of air. With regard to the two battleships now being built, the Nelson and Rodney, Admiral Sturdee could be assured that everything possible had been done in working out these designs to fulfil all known requirements. He would not expect details to be given. In the remarks about cruisers, the author did not mention the Hood, which was well protected and had effective bulge protection, or the Repulse and Renown. The Repulse had been bulged and the armour protection improved, and the Renown was now in hand at Portsmouth for similar alterations. All these three ships were 15in. gun ships of very high speed. As concerned the requirements laid down for a British cruiser, he could say that all the qualities mentioned by the author had been satisfactorily met in the cruisers recently designed, with the exception that it had not been so far possible to provide arrangements for launching aeroplanes. If any surplus displacement remained when the ships were completed, that point could be further considered.

Sir George Thurston said that his objection to the fitting of bulges was that whatever might be gained from the point of view of protecting the ship was more than counterbalanced by the great loss of speed associated with the bulge making it necessary to install enormously increased power. The author referred to the employment of a new type of underwater cruiser, and said he would like to know the kind of vessel Sir Doveton Sturdee had in mind. His own opinion was that a large submarine of the cruiser class could only operate in deep water, and any attempt to employ a vessel of that character in shallow waters would lead to very disastrous results. There were also disadvantages attached to the use of horizontal armour. Deck protection of that kind would add greatly to the weight of the ship. It was difficult also to decide what should be sacrificed to enable any effective use to be made of horizontal armour.

Engineer-Captain W. Onyon referred to the question of machinery in warships, of which no mention was, he pointed out, made in the paper. In Lord Jellicoe's book mention was made of troubles with condenser tubes, and the importance of the subject could be illustrated by the statement that the failure of one condenser tube practically wrecked the Lion. He was glad to say that two new materials suitable for the construction of condenser tubes were now available, and were immune from corrosion. The Admiralty knew all about these materials, and unhappy experience with condenser tubes made from the material ordinarily specified suggested that use would have to be made of the new alloys, even if they added to the cost of the machinery equipment. Another source of trouble was the priming of water-tube boilers at sea, and it was necessary to find a remedy. In connection with the use of poisonous gases in warfare the author suggested that perhaps the employment for purposes of propulsion of internal combustion engines would obviate the need for large air spaces. That was, of course, a misapprehension, and, as a matter of fact, more air would be required—the relation was 300 cubic feet to 334 cubic feet—if internal combustion engines were substituted in warships for steam plant. The loss of the Audacious went to show that in spite of all that could be done, it was not possible to prevent the loss of a ship from bottom damage.

Mr. W. H. Narbeth discussed the question of the vulnerability of the British battle-cruisers which were lost during the war. It appeared from the account given in Von Scheer's book of what happened to the Seydlitz in the Dogger Bank action, that the charges in the magazine were fired by flash, whereas in the case of the Queen Mary and her consorts the magazines detonated. It was a question of the difference in the quality of the explosives used in the British and the German navies, and it was a subject which called for the most careful consideration. Mr. Berry had mentioned the fact of the Admiralty staff being only large enough for the ordinary work, with no reserve for research, and that was a weakness which must be considered in the light of the demand made in the paper for designs to be kept up to date. The ideal plan would be to have a special staff to deal only with that branch of the work, so that the design of every foreign warship could be studied in detail. If that had been done in the pre-war period, we should have been taught many valuable lessons.

Sir Doveton Sturdee replied quite briefly to the points raised. He agreed that it was an advantage for the naval architect to know the views of the naval officer. Dealing with the gunnery aspect, it had to be admitted that the British ships were not trained to fire at the long ranges at which actions were fought in the war. The practice range was 9000 yards, and men had to be taught to use a range of 16,000 yards. Competitions in gunnery had been too apt to consider rather the number of hits on a target than the range and variations of weather and conditions under which an action at sea might have to be fought. On the disputed question of the function of the bulge and its advantages and defects, he agreed that the necessary protection should be given by the original design and not by the addition of the bulge. The expediency of concentrating on cruisers of 10,000 tons had been challenged, but as we were so deficient in cruisers of that class, their provision in adequate numbers must be the first consideration. The building of smaller cruisers could come later. With regard to what had been said by Mr. Berry, they were all agreed as to the need and value of research work, and money should be provided with the object of filling that need. Instead of ascertaining what was required in our warships through investigation and experiment, we had adopted the more costly method of building ships to acquire that knowledge. On the subject of the Navy generally, his own opinion was that at the present time we were less prepared for war than at any previous period of our existence. In putting forward his proposal for submarine cruisers, his idea was a vessel which would have the power to submerge for purposes of concealment. It was certain that if the power of submersibility had been possessed by the Emden, she would have had a much longer life. He was much interested in the suggested explanation of the superior resistance of German ships to the effects of gunfire.

On the motion of the President, a hearty vote of thanks was accorded to the gallant Admiral for his contribution to the proceedings.

The annual dinner of the Institution, which was held on the evening of April 9th, under the chairmanship of the Duke of Northumberland, was largely attended.

WATERLOO BRIDGE.

As a matter of topical interest, we give below a copy of a supplementary report on Waterloo Bridge made by the Improvements Committee of the London County Council, and dated April 2nd:—

"Waterloo Bridge was built in the early years of the last century, and was opened in 1817. The engineer responsible for its design and construction was John Rennie, and a drawing signed by him is still in the possession of the Council.

"Examination of old drawings shows that the foundation of each pier and of the abutments consists of timber piles about 20ft. long, driven in rows. Each row is capped by a whole timber sill or sill piece, across which further whole timber sills are laid, forming a gridwork of timber about 2ft. deep above the piles, the interstices being packed with stone. The gridwork is covered by a decking of timber about 6in. thick, upon which the masonry of the piers rests and was built.

"The bed of the river in and towards the centre is composed of gravel, but underlying the gravel is the London clay, which extends downwards for a great depth. The thickness of the gravel bed is relatively small. Under the masonry of the third and fourth piers from the Lambeth side the gravel is only about 9ft. to 10ft.; consequently, piles of the length shown on Rennie's drawings would pass right through the gravel and be standing in the London clay. It would appear from the original drawings that, when the bridge was constructed, the tops of the timber platforms were everywhere below the bed of the river. Such is not the case now, however, as in many cases the bed of the river between two platforms has been so eroded or scoured out that it is lower than the top of the platforms—that is to say, it is below the bottom of the masonry of the piers. The erosion or scouring is of long standing, and in 1882–4 the late Metropolitan Board of Works

expended about £62,000 in laying concrete slabs around the timber platforms, with the object of protecting them from erosion or scour.

"Settlement has occurred practically throughout the bridge, but is far more pronounced at the fourth pier from the Lambeth side than elsewhere. That which is now taking place at the fourth pier is an indication of that which may be expected at other piers. There is, in fact, a condition of unstable equilibrium, and it has to be borne in mind that such a condition often tends rapidly to become worse. The type of construction of these foundations is almost identical with that of old Southwark Bridge, which was built at the same time (opened in 1819) and by the same engineer as Waterloo Bridge. Both the foundations and the superstructure of old Southwark Bridge have been removed and others of a different design substituted, and we are informed that much of the old timber work in the foundations were found to be in a decayed condition.

"In our report now before the Council, reference is made to the fact that remedial measures are being taken in the hope that the settlement may be arrested, but that it is too early yet to say whether these will be successful. We desire to make it clear that these measures are not being tried with the hope that they may provide a permanent solution of the problem; they are only temporary remedial measures, having for their object the maintenance of the uninterrupted use of the surface of the bridge for road traffic or the waterways of the bridge for river traffic until a temporary bridge can be provided. This is, however, a question which is before the Highways Committee, and will be dealt with by them."

THE QUARTER'S SHIPBUILDING.

LLOYD'S REGISTER shipbuilding returns for the quarter ended March 31st show that the tonnage under construction in Great Britain and Ireland—1,473,629 tons—was about 78,000 tons more than at the end of December, 1923, but that there was still a decrease as compared with twelve months ago of about 19,000 tons. The total, however, includes 101,000 tons on which work is suspended. Deducting this tonnage in order to enable a comparison to be made with figures for normal times, it will be seen that the tonnage actually under construction at the end of March amounted to about 1,373,000 tons. The average tonnage being built during the twelve months immediately preceding the war was 1,890,000 tons, *i.e.*, 517,000 tons more than the present total. A slight decrease was shown in the tonnage commenced during the quarter, namely, 227,786 tons, as compared with 244,506 tons during the last quarter of 1923. The tonnage launched during the quarter ended December 31st, 1923, only amounted to 114,583 tons, whereas the total for the past quarter reached 361,508 tons.

The total merchant tonnage being built in other countries was 1,042,875 tons. It included about 118,000 tons upon which work has been suspended, leaving about 925,000 tons actually under construction. The latter figure is 57,000 tons less than at the end of December, 1923. The figures for the leading countries abroad are:—Germany and Danzig, 299,021 tons; Italy, 130,743 tons; United States, 119,767 tons; France, 111,610 tons; and Holland, 106,505 tons. From the table giving the number and tonnage of vessels launched and of vessels commenced in the world during the quarter under review, we learn that 188,738 tons were launched abroad and 203,820 tons were commenced, a decrease of about 29,000 and 24,000 tons respectively. The total world tonnage, 2,516,504 tons, includes 219,000 tons on which work is suspended. The tonnage actually under construction is thus 2,297,000 tons, which total is 1,149,000 tons below the highest pre-war record reached on June 30th, 1913, viz., 3,446,558 tons. There are at the present time under construction in the world thirty-three vessels of between 10,000 and 20,000 tons each and seven of 20,000 tons and upwards. Twenty-one out of the thirty-three and all the larger vessels, are being built in Great Britain and Ireland.

The returns show that there are at the present time thirty-five steamers and motor ships, each of over 1000 tons, with a total tonnage of 183,850 tons, under construction in the world for the carriage of oil in bulk. Of these tankers, twelve, of 74,600 tons, are under construction in Great Britain and Ireland. The tonnage of vessels now being built in the world which are to be fitted with internal combustion engines amounts to 694,712 tons, while the tonnage of steam vessels under construction is 1,801,716 tons. The motor tonnage thus equals 38¼ per cent. of the steam tonnage. These figures include fifty-five motor ships, each of between 5000 and 10,000 tons; four of between 10,000 and 15,000 tons; and seven of between 15,000 and 22,000 tons.

Of the vessels under construction in the world—which total excludes vessels the construction of which has not actually been commenced and also all vessels of less than 100 tons—431, of 1,517,859 tons, are under the inspection of the Society's surveyors, with a view to classification in Lloyd's Register Book.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RAILWAY ELECTRIFICATION.

SIR,—Your South African correspondent, Mr. Williams, is, I am glad to find, in agreement with myself as to the waste of money involved by endeavouring to supply direct current for distribution from the sub-stations at 1500 volts.

We have just had a discussion in Birmingham on Lieut.-Col. O'Brien's paper, and in order not to do any injustice to the esteemed author, I went quite independently into the matter of the electrification of the London-Birmingham section of the London, Midland and Scottish Railway, a distance of 108 miles.

I took the following premises:—Thirty passenger trains each way during twelve hours (day), this being double the present service; fifteen goods trains each way during twelve hours (night). The number of passenger trains taken is probably too high, but this is set off by the omission of a goods service during the day.

The figures taken gave 2,800,000 train miles per annum, corresponding with the third line of Lieut.-Col. O'Brien's Table VIII. Twelve trains would be simultaneously on the line at any moment of the day, and the headway would be 18 miles. The line is thus divided up, for "ideal" distribution, into six sections with two trains on each.

I have assumed that each train absorbs 1500 kilowatts, so that a pair of trains would absorb 3000 kilowatts. I have also assumed a 9-mile spacing of the sub-stations and a distributing copper cross section of 1 square inch on each pole—equivalent to 6 square inches if in iron—which allows a current density of 1000 ampères per square inch. Under these conditions I have worked out what would happen during the cycle while the two pairs of trains are changing place on the line, and I have found that roughly the average drop in the direct-current distribution system would be 16 per cent. If Colonel O'Brien had taken a 12-mile spacing the drop would be of the order of 20 per cent. I note, however, that in Table VI. of the paper the author has taken a 10 per cent. drop in the distribution system, and I therefore conclude that in order to bolster up his case he has been forced to put in a double copper section, the cost of which would be of the order of another £170,000, which must be debited to the 1500-volt system. The use of this pressure limits the spacing of the sub-stations to 12 miles, but the proper spacing should be 18 miles. It is clear that each sub-station must be able to deal for a time with two trains simultaneously passing it, and hence it must have a capacity of 3000 kilowatts. Nine sub-stations, each of 3000 kilowatts, gives a total of 27,000 kilowatts, whereas the ideal scheme would be to employ six sub-stations, each having a capacity of 3000 kilowatts, or a total of 18,000 kilowatts, which might be used if 3000 volts were employed. The 2 square inches of copper already alluded to could also probably be saved. The author has apparently taken £10 per kilowatt maximum demand at each sub-station and has so obtained £270,000 as the outlay on the sub-stations. I suggest, however, that unless he is figuring on rectifiers, it would be likely to take more nearly £15 per kilowatt, which brings the author's figures up to £405,000 and which would make his estimate appear £135,000 too low. If, on the other hand, the sub-stations were spaced 18 miles apart, the total cost would be £180,000 if taken at £10 per kilowatt, or £270,000 if taken at £15 per kilowatt, so that in the latter case he is spending unnecessarily £135,000 on the sub-stations, plus £170,000 on distributing copper, or a total of £305,000, which could be largely avoided by using a 3000-volt distributing system; Wages and other running costs of the additional sub-stations would also have to be considered. There is therefore, in my opinion, a clear case for the employment of 3000 volts.

Summing up the above figures, I submit, Sir, that Lieut.-Col. O'Brien has, owing to the unnecessary number of sub-stations (due to his low voltage), loaded his estimate with from £90,000 (rectifiers) to £135,000 (rotary converters) too much capital, to which must be added the £170,000 excess for distributing copper, due again to the 1500 volts. Total, £260,000 to £305,000 excess, entirely on account of 1500 volts.

As regards the use of single-phase locomotives, I do not pretend to know how these compare in cost with direct-current locomotives; but as regards efficiency, the higher voltage possible with alternating-current distribution would much more than compensate for any slight difference in the efficiency of the locomotives.

With alternating-current electrification the rotary converter sub-stations (or rectifiers) and the surplus "distribution copper" disappear; *i.e.*, we save £260,000 to £305,000, and we could probably halve the section of the copper which I have retained and so save another £170,000 ÷ 2 = £85,000. Total saving = £345,000 to £390,000 (*i.e.*, assuming the locomotives cost equal sums on both schemes, excluding transformers.

But now we must debit the alternating-current scheme with 18,000 kilowatts of transformers (static) at, say, £2 per kilowatt, including buildings and also including (?) the transformers on the locomotives, *i.e.*, £36,000. The net saving is therefore (£345,000 − £36,000) = £309,000 (rotaries) to (£390,000 − £36,000) = £354,000 (rectifiers).

I give these figures without prejudice, because I do not know anything about the price or performance of alternating-current locomotives, and dare not therefore take up the cudgels on behalf of the alternating-current scheme. But what I do put forward is this:—If Colonel O'Brien, hampered by £309,000 to £354,000, can show that main line railways are going to pay on a traffic corresponding with the 16,000 engine miles per track mile per annum of his Table VIII., how much better a showing would he not make if he had taken figures for single-phase locomotives?

With regard to the statement of your correspondent (paragraph 5 of his letter), viz.:—"If a series of sub-stations, with cheap power for sale, were strung out at equal intervals along a line between London and Birmingham, how much of the present concentration . . . North and South." I submit that if direct-current electrification be undertaken, the right thing to do is to put in a transmission line with underground cables. The regulation obtainable at the sub-stations under such conditions would be totally impracticable for the public supply of electricity, and I feel very strongly that the right thing is to put in a transmission with underground cables at the highest possible voltage. I am in a position to prove that assuming, for example, that if the "hexaphase" system were put down of such capacity as to have several times the capacity of the needs of the railway, power could be fed from either end of the line for general distribution purposes on a large scale to towns on the route, or again right through from London to Birmingham or *vice versâ*. The cost for interest and depreciation on such a line would be very much lower than on the overhead system, intended for equal voltage; in fact, it would only be of the order, with a 20 per cent. load factor, of .001d. per unit. Transmission loss from, say, London to Birmingham, or Birmingham to London, would have to be added to this, but need not be of the order of more than .02d. per unit for the same outlay, and this could in fact be reduced to .01 by increasing the copper section, at an extra capital charge of only .001d. per unit. The result would be that there would be a means for linking up large power stations with a north-and-south trunk line, capable of giving power at cheap rates along the route and developing the resources of the country.

For example, if power in London were to cost .45d. per unit and in Birmingham it were to cost .49d. per unit, there would be a clear gain, with a liberal margin in hand, in transmitting power from Birmingham to London. In fact, a difference of only .02d. per unit in the price between Birmingham and London would amply warrant commencing interchange of current from one to the other.

It is worth mentioning that the interest and depreciation charges alone on the line for the amount of power mentioned above would be of the order of £113,000 per annum, but this would be paid by the companies or municipalities utilising the line, and if the railway company saw fit to double or even treble this charge it would make practically no difference to the prospects of the companies or municipalities passing power over the line, but would put money into the coffers of the railway company to the tune of £200,000 or £300,000 per annum, over and above the charges that the railway company would otherwise have had to pay for maintenance of the trunk main.

It is true that these figures are based on my "hexaphase" system, but even supposing that nothing were available better than single-phase cables, and that the limits which are now in serious contemplation by our American friends in connection with single-phase cables were found satisfactory, the results would only be reduced by some 40–50 per cent. and would still be well worth considering.

As regards the use of overhead 44,000/60,000-volt transmission, I have also looked into the question of transmission of the power from the generating station. Assuming that power was fed from each end of the line, as, for example, from London and Birmingham, the overhead conductors put forward by Lieut.-Col. O'Brien would only just do their work if the two parallel lines were both employed and if one broke down the drop would be serious.

I believe that 40,000/60,000 volts is altogether too small a pressure to be employed for such a purpose, and also that the overhead system is not one that should be employed.

If three-phase current and 50 periods be supplied for general supply purposes to smaller towns on the route from the various sub-stations a power factor of the order of 0.8 would have to be faced instead of a unity power factor, which has been taken in the present case, and which would be unworkable unless the power factor of unity be assumed, and even then the drop is normally of the order of 10 per cent. If, however, the power factor of 0.8 had been assumed, the drop immediately would be doubled, and under breakdown conditions would be 40 per cent.

One other point perhaps I may touch on, viz., your correspondent's paragraph 7, viz.:—"If this conclusion is accepted it will naturally follow that every sub-station will be supplied with three-phase current at standard frequency . . ." Bearing in mind that the possible sales of power along the line (or transference from London to Birmingham or *vice versâ*, if my suggestions be accepted) may prove to be a much bigger load than even the traction load itself, I am not at all sure whether it might not pay to have 25-period locomotives (which I am advised are only 2 or 3 per cent. less efficient than at 15 periods) and to have single-phase 25-period supplies tapped off the three-phase 25-period sub-stations; since, if the "general supply load" is to be so much bigger than the traction load, the "unbalancing" would be of no particular moment. London, Birmingham and Glasgow would no doubt be quite willing to give 25-period supplies, and the cable transmission (underground) is very much more efficient and free from resonance and satisfactory at 25 periods than at 50 periods; and, moreover, single-phase cables become practicable for high voltages at 25 periods.

As regards inductive interference with telephones, I may say that the underground cable system—whether single-core cables or "hexaphase"—can be arranged to be practically immune as regards interference with telephones, and the latter could certainly still be retained overhead.

A. M. TAYLOR.

Birmingham, April 5th.

WHAT IS WRONG WITH ACCOUNTANCY?

SIR,—My attention has been drawn to a letter with the above title over the initials "F. H. A.," in your issue of the 28th ult. There are many causes for the present deadlock, but I will content myself with touching on one or two.

While it is true that wages, salaries, and dividends, *i.e.*, purchasing power, have entered into costs at some time, it must not be forgotten that, as work is represented by force multiplied by distance moved through, so cost is really a product of a limited amount of money multiplied by the number of times it has circulated. Total cost is therefore greater than total money.

Again, plant, &c., which increases the productive capacity of a concern and which already has been paid for once, is considered in accountancy as a charge on the concern, and attempts are made to recover this charge and the interest thereon in prices; consequently the greater the capitalisation, the more intricate and perfect the productive machine, the greater is the proportion of the total financial cost of the production of that concern figured as "overheads," and the less as purchasing power. But unless purchasing power distributed at any one time is at least equal to prices of goods and services delivered at the same time it is obviously impossible for purchase of production to take place.

I hope the foregoing has shed some light on the problem, but for complete illumination I would refer "F. H. A." to Major C. H. Douglas' recent book, "Social Credit."

R. GAUDIN, A.M. Inst. C.E.

London, April 5th.

THE SEINE FLOODS.

SIR,—I think "Economist" in his letter on the Seine floods in your issue of March 28th, answers his own suggestion when he states that the flow of the river would be much "more strong and swift," *i.e.*, by the formation of a cut 11 miles long, shortening the river's present course by 24 miles.

In Sir Edward Thorpe's book, "The Seine from Havre to Paris," published 1913, page 8, he states:—"So Serpentine a track may seem at first sight to detract from the value of the Seine as a trade waterway, but it has its compensations in reducing the fall of the river, and in retarding the velocity of its current, thus rendering its canalisation in parts more easy."

He gives the fall between Paris and Elbeuf, the last lock above Rouen, as 76ft. in 135 miles or an average of 6⅞in. per mile.

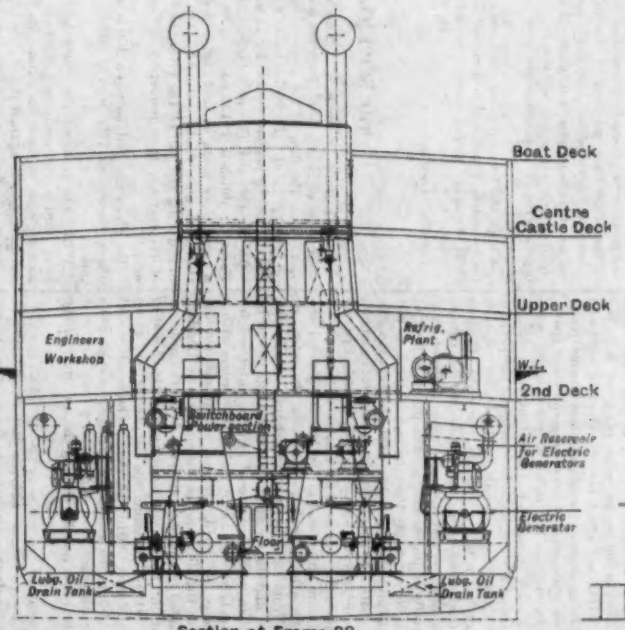
With this gradient the current would be over 3 miles an hour, and a cut such as suggested by "Economist" would increase this to such an extent as to render it impossible to navigate vessels against it.

After all, floods occur only occasionally, while navigation is continuous and an increasing quantity, and the deepening and regularisation of the present channel would improve navigation and also alleviate the flood trouble, so that any money available will be better expended on improving the present channel rather than on the construction of fresh relief cuts.

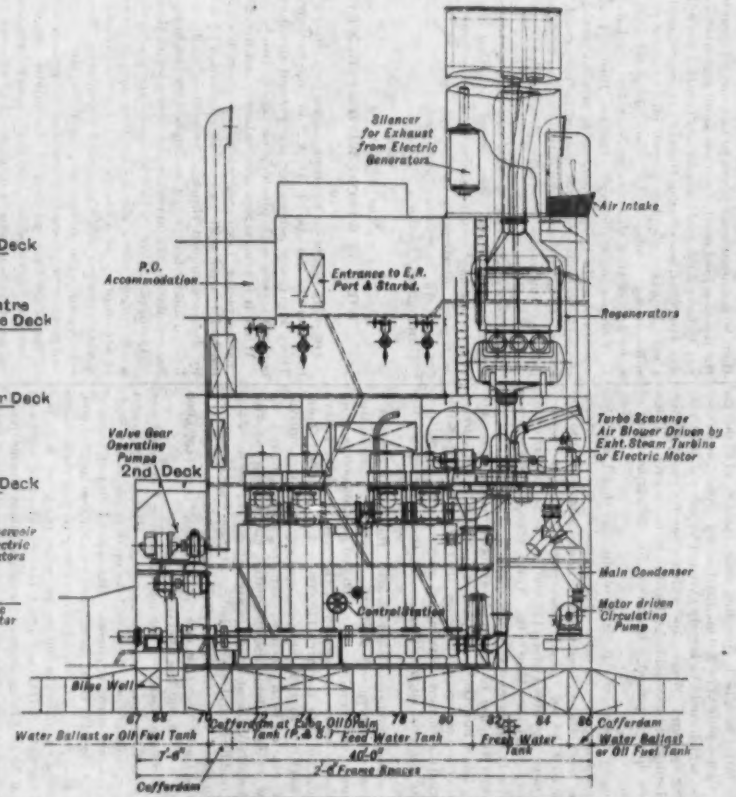
8th April. FENLAND.

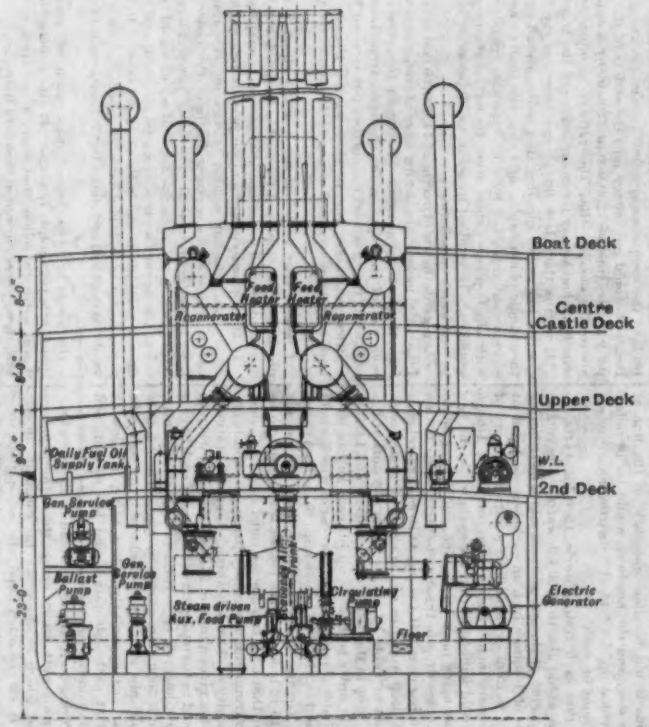
ARRANGEMENT OF THE MACHINERY OF THE MOTOR SHIP DOLIUS

SCOTTS' SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, GREENOCK, ENGINEERS

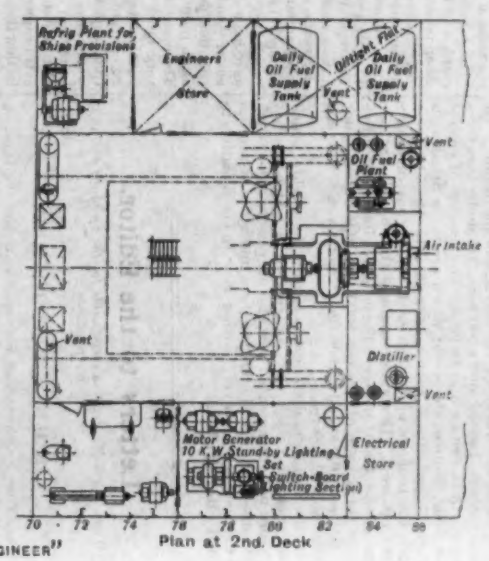


Section at Frame 82
Looking Aft.

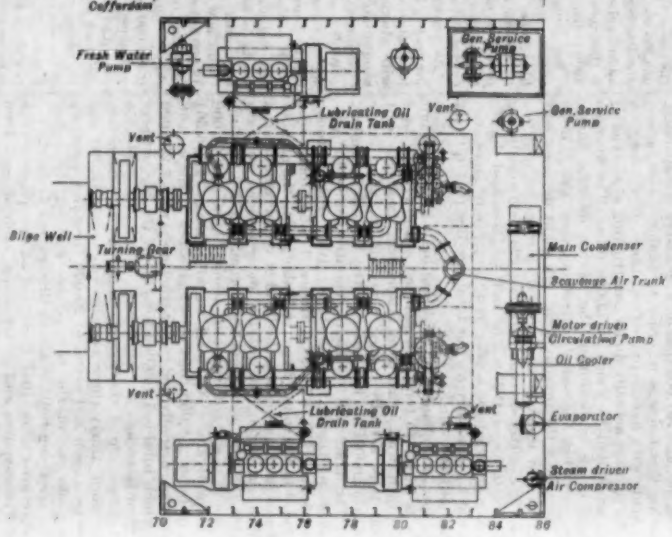

Silencer for Exhaust from Electric Generators
Air Intake
P.O. Accommodation
Entrance to E.R. Port & Starbd.
Regenerators
Turbo Scavenge Air Blower Driven by Exht. Steam Turbine or Electric Motor
Valve Gear Operating Pump
2nd Deck
Main Condenser
Motor driven Circulating Pump
Control Station
Bilge Well
67 68 70 Cofferdam at F.Wtr. Oil Fuel Tank 76 78 80 82 84 86 Cofferdam
Water Ballast or Oil Fuel Tank
Fresh Water Tank
Water Ballast or Oil Fuel Tank
7'-6"
40'-0"
2 cl Frame Spaces
Cofferdam

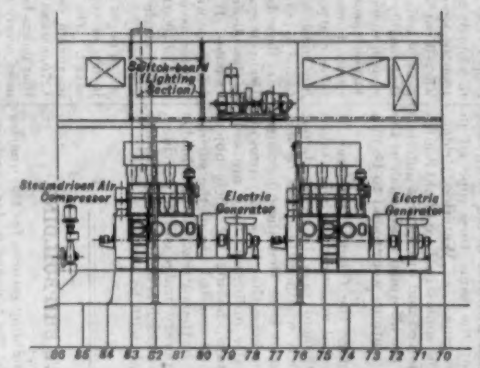


Section at Frame 82
Looking Fwd.



Plan at 2nd. Deck




Switch-board Lighting Section
Steam driven Air Compressor
Electric Generator
Electric Generator
80 85 84 83 82 81 80 79 78 77 76 75 74 73 72 71 70

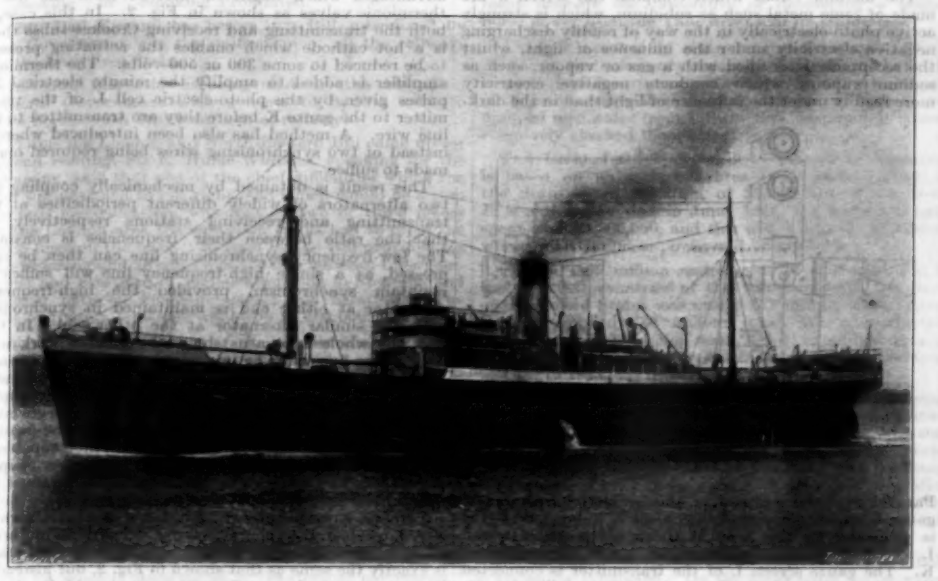
Elevation Looking to Starbd Side

"THE ENGINEER"

SWAIN Sc.

THE SCOTT-STILL MOTOR SHIP DOLIUS

SCOTTS' SHIPBUILDING & ENGINEERING CO., LTD., GREENOCK, BUILDERS & ENGINEERS



The Motor Ship Dolius.

THE demonstration trials of the Blue Funnel Line motor ship Dolius took place in excellent weather, on the Firth of Clyde, on Friday of last week. They marked an event of considerable importance in the evolution of the British marine oil engine, and a very large and widely representative company of engineers accepted the invitation of the owners, Alfred Holt and Co., and the builders, Scotts' Shipbuilding and Engineering Company, Limited, Greenock, to view the ship and her propelling machinery. As doubtless will be remembered, the main propelling machinery of the Dolius is of peculiar interest on account of its being the first large scale application of the Scott-Still marine oil engine to the propulsion of ships, and the system is the more noteworthy because the conception, design and development of the engine is entirely British and wholly independent of the initiative of guidance of continental engineers. In the present article we do not propose to describe in detail the Scott-Still engine, since that prime mover was the subject of two illustrated articles which appeared in our issues of November 23rd and 30th last, when the shop trials were run. It may, however, be useful to describe the arrangement of the engine-room lay-out, and to give some impressions of the installation, which can only be formed after seeing the complete arrangement of machinery in the ship.

The accompanying half-tone engraving shows the Dolius off the tail of the bank at Greenock ready for trials. In appearance she is not unlike other well-known ships of the Blue Funnel Line, and her general particulars are as follows :—

Leading dimensions of ship—	
Overall length	423ft.
Moulded breadth	52ft.
Moulded depth	23ft. 6in.
Displacement	11,370 tons
Gross tonnage	5,700 tons
Service speed	11 knots
Propelling machinery—	
Number of engines	Two four-cylinder Scott-Still
Diameter of cylinders	22in.
Piston stroke	36in.
Normal rating each engine	1250 S.H.P.
Revolutions per minute	120
Boiler pressure	140 lb. per square inch
Steam pressure at cylinders	70 lb. per square inch
Average combustion, M.E.P.	78 lb. per square inch
Average steam, M.E.P.	6.6 lb. per square inch
Mechanical efficiency	87.7 per cent.
Estimated average fuel consumption at sea	0.36 lb. per S.H.P. hr.
Length of engine bed-plate	24ft.
Width of engine bed-plate	9ft. 3in.
Overall height to cylinder tops	22ft. 2in.
Approximate weight of one engine complete with piping	134 tons

The drawings which we reproduce on the opposite page will serve to show the general arrangement of the installation. Several features remind us of the familar combination of reciprocating and turbine machinery adopted in steamship practice. In this case, however, the main engines operate on the two-stroke cycle principle, with port scavenging, while steam pressure with two-stage expansion is used on the lower sides of the main pistons, the oil fuel being burned on the top side of the piston as in ordinary internal-combustion practice. Entering the engine-room from the centre castle deck level, a gangway platform and ladder give access to the first platform at upper deck level. Right forward are grouped the two main boilers or regenerators with the feed-water heaters, which, in addition to extracting the heat from the outgoing gases, serve as excellent silencers. In between them is the main scavenge air inlet trunk, which communicates with the air intake immediately behind the funnel at about boat deck level. We noted that the slight ringing noise which is inseparable from high-speed turbo-blower work was very moderate and showed that care had been bestowed on the design of the intake system. Immediately above the first platform over each engine cylinder are placed runways and lifting gears to facilitate dismantling and erection. A further ladder leads to the second platform at cylinder cover level, which extends the whole width of the ship and gives space on the wings for engineers' shops and stores. The platform is arranged so as to give easy access to the fuel-injection valves and indicating gear, and in connection with the valves we noted on the after bulkhead a series of testing devices with a hand pump equipment enabling the fuel valves and spill valves to be proved at both internal and external working pressures. In the centre of this space forward is placed the turbo-scavenging blower driven on one side by a low-pressure steam turbine, and coupled on the other to an electric motor used for starting purposes. The turbine is supplied with exhaust steam from the engine cylinders, and constitutes the third stage of steam expansion. With the ship in the light condition in which the trials were run only 35 electrical horse-power was put into the blower by the electric motor, the remainder of the power being supplied by the exhaust steam. When running with the ship fully loaded, more than enough steam to drive the blower will, we understand, be generated, and the electric motor may then be run as a generator and can supply power to the mains.

Alongside the blower are placed the pumps and heaters for the oil-burning installation fitted to the boilers, and also a distilling plant. In addition to the workshop, which is furnished with a motor-driven lathe, drilling machine, and grinding wheel, and the engineers' and electrical stores, there is at this level the refrigerating plant for ship's use, and a 10-kilowatt standby electric lighting plant with the lighting switch board. The generating engine is of the hot-bulb type, built by W. H. Allen, Sons and Co., Limited, of Bedford, which firm also supplied a small motor generator for 110 volts lighting current. The main electrical control gear is placed aft at the third platform level, and comprises a seven panel board made by the Sunderland Forge Company, Limited, Belfast. Alongside this switchboard are fixed the motor-driven pumps which supply high-pressure oil for operating the steam valves and the manœuvring gear. At this level complete access is given to the cylinder casings and mechanical lubricators. Reference may here be made to the flap valves, which are built into the exhaust pipes and interposed between the exhaust ports of each cylinder and the primary regenerators. These valves have an excentric motion and, although open during the exhaust period, close immediately the piston rises above the scavenge ports. By this means a larger volume of scavenge air is entrained in the cylinder and is available for combustion. The starting and manœuvring controls are placed centrally between the engines at floor plate level. The various pumps and other auxiliaries, including the motor-driven turbo-condensing plant, are neatly arranged along the forward bulkhead and also in part of the port wing, as shown in the accompanying drawings. There are three auxiliary Diesel electric-generating plants, two of which are placed in the starboard wing and on the port side. Each unit is designed to supply direct-current at a pressure of 220 volts, and comprises a three-cylinder Burmeister and Wain type engine, built by W. H. Allen, Sons and Company, Limited, Bedford, and coupled direct to a 100-kilowatt generator built by the same firm. The reason why such a large auxiliary electrical plant is installed is in accordance with the owners' practice adopted for heating and lighting throughout the ship and for the operation of deck auxiliaries and steering gear. The steering gear is of the hydraulic electric type, built by John Hastie and Co., Limited, Greenock. Altogether there are 13 cargo winches, nine of which are spur geared and four worm driven, one being provided with extended warping ends. The winches were supplied by John H. Wilson and Co., Limited, Birkenhead, and are driven by Laurence Scott motors. Messrs. Wilson also supplied the electric cooking ranges and other galley equipment. All cabins are electrically heated, vapour type radiators being used.

TRIAL RESULTS.

The demonstration trials we attended followed those of the Marine Oil Engine Trials Committee, which were carried out on the two previous days. We think it desirable to await the trial results, which will be published in the report of the committee, and propose, therefore, only to indicate in a general way the conditions under which the engines were run. When fully loaded the Dolius will carry some 8000 tons of cargo, but on Friday last she was only loaded with water ballast of about 2300 tons. The total water ballast is 2835 tons, and is carried in two deep tanks in the double bottom and the after peak.

In the partially loaded condition in which the ship was run it was not, therefore, possible to work the engines at maximum capacity. Although the normal mean effective pressure on the combustion side of the cylinders is between 78 lb. and 80 lb., that indicated during the demonstration trials was not more than 56 lb., with possibly only 4 lb. or 5 lb. on the steam side of the cylinders. This corresponded to an average ship speed of about 11¼ knots. The engines were run at 122 revolutions per minute, and we noted the following readings at the control platform. Valve gear oil pressure, 360 lb. per square inch; lubricating oil pressure, 10 lb.; scavenging air pressure, 1.1 lb. to 1.2 lb.; vacuum, 27in. to 27½in. The fuel oil used was a comparatively light oil of 0.89 specific gravity, with a heating value of about 18,500 B.Th.U.'s per pound, supplied by the Anglo-American Oil Co., Ltd. An interesting feature of the trials was the use of a Moullins patented distant reading torsion meter, which was employed to determine the shaft horse-power and to take continuous records over stated intervals. The readings will, we understand, be included in the report of the Marine Oil Engine Trials Committee. Throughout the day the engines ran very smoothly, and in manœuvring, telegraph orders were smartly complied with. During a continuous manœuvring trial of from 4 to 5 minutes, the average time taken from full speed ahead through the stop position to a given speed astern was, we were informed, about 15 seconds. In our previous article we made reference to the noticeably quiet running of the engine. On the day of the trial last week there was perhaps a little more noise than during the test bed trials, which may be satisfactorily explained by the fact that minor adjustments in fuel injection timing have still to be made in order to compensate for a slightly different level of the fuel tanks in the ship, as compared with bench-trial conditions. The Dolius will shortly leave on a maiden voyage to Algiers, carrying outwards a full cargo of coal and inwards a cargo of iron ore. She marks a further most interesting addition to the commercial fleet so ably managed by Alfred Holt and Co., and we look forward to the time when it will be possible to compare her performance with that of her sister motor ship, the Medon, which is engined with Burmeister and Wain machinery, and with similar steamships.

Television.

SINCE the introduction of broadcasting, a great deal has been published about the possibility of distant vision, or seeing by wire or wireless, but so far no practical method of real electrical television has, so far as we are aware, actually materialised. For many years past, however, scientific investigators have had this matter under consideration, and a certain amount of experimental work has been carried out. At a recent meeting of the Radio Society of Great Britain, Mr. Campbell Swinton gave an interesting lecture on the subject, in which he reviewed the work that has been done, and described a system which he has thought out and which he thinks might possibly work. Unfortunately, we cannot find space to deal with the historical ground which Mr. Campbell Swinton covered, and we must confine ourselves mainly to the author's system, which incidentally was originally described some years ago before the Röntgen Society.

In considering in what way the problem can be solved, investigators naturally turned their attention to the structure of the human eye. As everyone knows, that organ consists of a camera obscura, containing a lens, whereby the image of what is looked at is thrown upon the retina, just as it is thrown upon the ground glass screen or on the sensitive plate in a photographic camera. The surface of the retina is connected with the brain, through

the optic nerve, by means of a very large number of threads or fibres, each of which connects with a certain definite point on the retina, and thus, under the stimulus occasioned by light falling upon it, communicates to the brain in mosaic form a conception of the different portions of the image.

As is well known to everyone who has had experience with the so-called process of half-tone blocks employed for the modern printing of illustrations, it is possible to represent pictures of every kind by a sufficiently large number of sufficiently small black dots on a white surface. When looked at from a distance at which the eye cannot distinguish the dots, the picture presents itself in a satisfactory manner to the observer, and white dots on a black surface will do just as well if properly disposed. Imagine, then, that for the television receiver we have a black surface entirely covered by very minute electric lamps, each connected by a separate wire to the distant transmitter, which may consist of another surface entirely covered with small selenium cells, the electrical resistance of which is reduced when light falls upon them. Now imagine that upon the surface composed of all these cells the image that is to be transmitted is thrown by means of a lens, just as the image is thrown by the lens of the eye upon the retina. Certain of the cells on which a bright light falls will have their resistance lessened to a great extent, whilst others on which the incumbent light is less strong will have their resistance reduced to a less degree, and those in the dark portions of the image will not be affected at all.

Let it be supposed, then, that these cells are connected by numerous wires to the lamps which form the surface of the receiver, care being taken to see that each cell of the transmitter is connected to the correspondingly placed lamp of the receiver, and that these electric circuits are completed by a wire or by connection at both ends to earth with a battery of suitable size interpolated. Then with proper adjustment the lamps which are connected with the selenium cells on which the bright portions of the image are thrown will light up brightly, whilst those lamps that are connected with the cells on which the less brightly illuminated portions of the image fall will only reach semi-incandescence, while the remainder connected with the cells in the dark portion of the image will not light at all. Thus, on the surface of the receiver a fairly exact reproduction of the image thrown on the receiver should be obtained. This idea is very old, but it is quite obvious that the very large number of lamps and wires required renders it impracticable. Another method, H and J simultaneously. In the transmitter the screen J, which is gas-tight, is formed of a number of small metallic cubes, insulated from one another, but presenting a clean metallic surface to the cathode rays on one side and to a suitable gas or vapour, say, sodium vapour, on the other.

The metallic cubes which compose the screen J are made of some metal such as rubidium, which is strongly active photo-electrically in the way of readily discharging negative electricity under the influence of light, whilst the receptacle K is filled with a gas or vapour, such as sodium vapour, which conducts negative electricity more readily under the influence of light than in the dark.

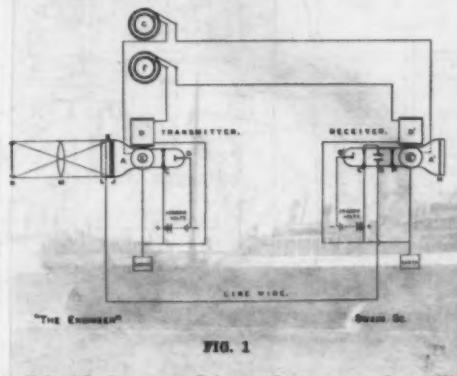


FIG. 1

Parallel with the screen J is another screen of metallic gauze L, and the image of the object N to be transmitted is projected by the lense M through the gauze screen L on to the screen J through the vapour contained in K. The gauze screen L of the transmitter is connected through the line wire to the receiver to a metallic plate O, past which the cathode rays have to travel. There is also a diaphragm P fitted with an aperture in such a position with regard to the inclined position of B as to cut off the cathode rays coming from the latter, and prevent them from reaching the screen H, unless they are slightly repelled by the plate O, when they are able to pass through the aperture.

Turning now to the principle on which the apparatus works, assume a uniform beam of cathode rays to be passing in the Crookes tubes A and A^1, and that the magnets D and E and D^1, E^1 are energised with alternating current in the manner described. Assume also that the image to be transmitteed is strongly projected by the lens M through the gauze screen L on to the screen J. Then as the cathode rays in A oscillate and search out the surface of J they will in turn impart a negative charge to all the metallic cubes of which J is composed. In the case of the cubes on which no light is projected nothing will happen, the charge dissipating itself in the tube. But in the case of those cubes which are brightly illuminated by the projected image the negative charge imparted to them by the cathode rays will pass away through the ionised gas along the line of the illuminating beam of light until it reaches the screen L, whence the charge will travel by means of the line wire to the plate O of the receiver. This plate will thereby be charged. It will slightly repel the cathode rays in the receiver and will enable those rays to pass through the diaphragm P, and impinging on the fluorescent screen H to make a spot of light.

This will occur in the case of each metallic cube of the screen J which is illuminated, while each bright spot on the screen H will have relatively exactly the same position as that of the illuminated cube at J. Consequently as the cathode ray beam in the transmitter passes over in turn each of the metallic cubes of the screen J it will indicate by a corresponding bright spot on H whether the cube in J is or is not illuminated, with the result that within one-tenth of a second H will be covered by a number of luminous spots corresponding to the luminous image thrown on J by the lens M, and the image can be reconstructed in a mosaic fashion.

By making the beam of cathode rays very thin, by employing a very large number of very small metallic cubes in the screen J, and by adopting a very high rate of alternation in the dynamo G, the luminous spots on H can be made very small and numerous, with the result that the more these conditions are observed the more distinct and accurate will be the received image. By employing a fluorescent material on the screen H, which has had a certain degree of persistency in its fluorescence, it is possible to reduce the rate at which the synchronised motions and impulses take place.

Mr. Campbell Swinton referred to a number of modifications that might be used in these days, and mentioned the advantages which might be derived from the use of thermionic valves as shown in Fig. 2. In this case, in both the transmitting and receiving Crookes tubes there is a hot cathode which enables the actuating pressure to be reduced to some 300 or 500 volts. The thermionic amplifier is added to amplify the minute electrical impulses given by the photo-electric cell L of the transmitter to the gauze K before they are transmitted to the line wire. A method has also been introduced whereby instead of two synchronising wires being required one is made to suffice.

This result is obtained by mechanically coupling the two alternators of widely different periodicities at the transmitting and receiving stations respectively, so that the ratio between their frequencies is constant. The low-frequency synchronising line can then be suppressed, as a single high-frequency line will suffice to maintain synchronism, provided the high-frequency alternator at either end is maintained in synchronism with the similar alternator at the other end. In this way the whole apparatus should be able to work with only three line wires or two wires and an earth connection. Indeed, it might be possible to do away with the synchronising line altogether, and if the two coupled alternators, say, at the transmitting end, could be governed to run at a very uniform speed then it might be possible by means of a sufficiently accurate governor capable of very delicate adjustment to run up the two coupled alternators at the receiving end until they attained the exact speed desired.

Perhaps a more interesting scheme is that shown in Fig. 3, in which the apparatus is worked without any wires at all. The main transmitting and receiving apparatus is exactly the same as that shown in Fig. 2, but instead of line wires a wireless equipment is used. At the transmitting end the electric impulses imparted by the photo-electric cells to the wire gauze are caused to actuate an ordinary wireless transmitting apparatus, which supplies a radiating aerial in the usual manner. At the receiving end the signals are received on a tuner and amplifier before they are passed on to the Crookes tube. No special means are shown for effecting synchronisation, as it is hoped that the method just described could be used. Synchronisation could, however, be obtained by

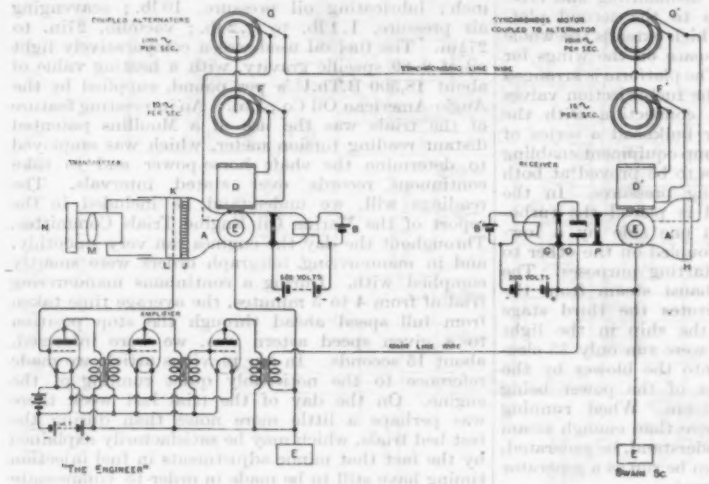


FIG. 2

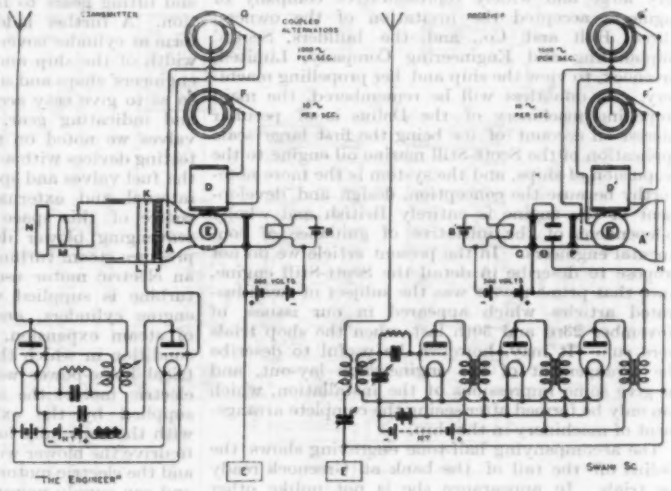


FIG. 3

invented about twenty years ago, makes use of exceedingly minute synchronously oscillating mirrors at the transmitting and receiving stations.

We must pass on, however, to Mr. Campbell Swinton's method. In the diagram, Fig. 1, the transmitter is shown on the left-hand side and the receiver on the right-hand side. The transmitter consists of a Crookes tube A, fitted with a cathode B, which sends a cathode ray discharge through a small aperture in the anode C, the cathode rays being produced by a battery or other source of continuous current giving a pressure of about 100,000 volts. D and E are two electro-magnets placed at right angles to one another, which when energised by alternating current will deflect the cathode rays in a vertical and in a horizontal direction respectively. The receiving apparatus consists of a similar Crookes tube A^1, fitted with a cathode B^1, which in circumstances to be described later transmits cathode rays through an aperture in the anode C. D^1 and E^1 are two electro-magnets placed at right angles, similar to those in the transmitter, the two magnets D and D^1, which control the vertical motions of the cathode ray beam, being energised from the same alternating current dynamo F, which has a frequency of, say, 10 complete alternations per second, while the two other magnets E and E^1, which control the horizontal movements of the cathode ray beam, are energised by a second alternating-current dynamo G, having a frequency of, say, 1000 complete alternations per second.

In the receiver is a fluorescent screen H, upon which the cathode rays impinge, and the whole surface is searched out every tenth of a second under the combined deflecting influence of the two magnets D^1 and E^1, with the result that with these conditions the screen fluoresces with what appears to the eye as a uniform brilliancy. Similarly, in the transmitting apparatus the cathode rays fall on the screen J and search out the surface every tenth of a second under the influence of the magnets D and E. As the two magnets D and D^1, E and E^1 are energised by the same currents, the movements of the two beams of cathode rays will be exactly synchronous, and the cathode rays will always fall on each corresponding spot of the two screens

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A PRELIMINARY statement containing summarised particulars of the accounts and statistical returns of the railways in Great Britain for the year 1923, compared with the years 1922 and 1913, has been issued by the Ministry of Transport. In addition to totals for Great Britain, the statement shows separately the aggregate figures for the companies constituting each of the four new groups. The tables show the capital expenditure and receipts, the revenue receipts and expenditure from railway working, the total net receipts, the appropriations of net income and a summarised balance sheet. They also show the number of passengers carried, the tonnage conveyed, the average receipts per ton and per ton-mile and the leading operating statistics. The complete railway returns will be issued later in the year.

THE death of Mr. Ammon Beasley, who was the general manager of the Taff Vale Railway until 1917, when the interests of the Taff Vale, Rhymney and Cardiff Companies were combined under Mr. E. A. Prosser, reminds us of the origin of the much-discussed Trades Disputes Act of 1906. In the year 1900 there was a strike on the Taff Vale Railway, out of which arose an action by the railway company against the Amalgamated Society of Railway Servants. The crucial point was whether a trades union could be sued. The lower court decided that it could and issued an injunction, but the Court of Appeal reversed the judgment which, however, was upheld in the House of Lords. Five years later, when the Liberals came into power, trades unions were protected against any action they took during a trades dispute. In Bristol and South Wales areas Mr. Beasley will also be remembered as, for many years, the president of the Bristol Channel Dock Owners' Association.

Railway Matters.

ALL cars on the Metropolitan Railway are now labelled "Smoking" or "Smoking Prohibited."

THE Dail Eireann has before it a Bill, introduced by the Government, for the unification of all the railways in the Irish Free State.

ANOTHER inspection is being made by the Australian Federal Government with a view to finding a route for a north-south Transcontinental railway.

WHEN the London and North-Eastern Bill came up for second reading, Sir E. Hume-Williams, speaking for the company, said that one of the chief difficulties which the Bill was designed to put right, and which would be a step towards electrification, was that at two or three places in the London area the suburban trains had to cross the main lines on the level. To meet it, the Bill provided for the widening and alteration of the line between Liverpool-street and Stratford, a similar alteration in Stepney, and another between Fenchurch-street and Stratford. The cost of these alterations would be £1,500,000.

AT the annual meeting of the Mersey Railway Company, the chairman said that a length of ¾ mile of track under the river had been laid with the heaviest section of standard rail in use in this country—100 lb. to the yard—and this had had the effect of improving the running of the trains and reducing the cost of maintenance on that portion of the permanent way. The results had been so satisfactory that it had been decided to proceed with the renewal of a similar length on the other road, and as time went on and renewals were required, the use of heavy section of rail would be still further extended.

OPINION in the United States is divided as to which of several railway events about one hundred years ago should serve for what is there called a "centennial movement." In 1926 it is proposed to commemorate the 150th anniversary of the Declaration of Independence, and some would associate the beginning of American railways with that event, especially as it would be one hundred years since the opening of the 3-mile wagon-way from some stone quarries near Quincy, Mass., to the sea. On July 4th, 1828, Charles Carroll, of Carrollton—one of the signators of the Declaration of Independence—laid the beginning of the Baltimore and Ohio Railroad, the first built in America for public use; whilst the following year, 1929, saw the arrival of Stourbridge Lion.

UNDER Secs. 9 and 10 of the Companies Clauses Act, 1845, railway companies, with other public concerns, have to keep a book in which are to be entered the names of the stockholders and another book with their addresses. This regulation has now been altered. The four amalgamated railway companies obtained in their Acts of last year release from the obligation to print their shareholders' address books until the end of 1925. Certain of the London Underground Railway Companies obtained legislation last year which permanently relieved them of the obligation to print their shareholders' address books, on condition that such books should be open to inspection by shareholders free of charge and by other persons on payment of a fee not exceeding 1s.

THE Minister of Transport—Mr. H. Gosling—received a deputation of members of the Parliamentary Industrial Group at the House of Commons on the evening of the 3rd inst. The deputation urged upon the Minister the need for the improvement of transport facilities and the promotion of schemes for the electrification of railways, particularly between York and Newcastle, in Glasgow, and in the neighbourhood of Liverpool and Manchester. The proposal was that the committee under the Trade Facilities Act should give more generous consideration to schemes of railway electrification than has been hitherto given. Mr. Gosling is stated to have been very sympathetic towards the proposals and promised to take them into immediate consideration.

THE month of April, like that of February—see this column of THE ENGINEER of February 22nd last—has never, of recent years, seen a serious railway accident. Prior to the April of 1902, we have to go back to April 19th, 1882, when a passenger train over-ran a signal at St. Paul's-road Passenger Junction signal-box, Midland Railway, owing to some lime falling and blinding the driver. Two passengers were killed then. In April, 1902, one passenger was killed at Sutton Coldfield, owing to the driver over-running a home signal after being cautioned, and three at Hackney Downs owing to a broken axle on a passenger coach, and in April, 1905, two were killed in a collision at Huddersfield because a driver failed to notice that a shunting signal was against him.

THE London and North-Eastern Railway Company spent on capital account last year £767,835, of which £575,948 went on new works. For new sleeping cars there was an expenditure of £28,632; on land, buildings, plant and machinery for manufacturing and repairing workshops, £113,427 were spent; whilst on docks the expenditure was £45,024. During the present year it is proposed to spend £1,078,300 on capital account. This sum includes £467,200 for new works on lines opened for traffic; £89,900 on new lines and £149,000 on widenings of and additions to existing lines. A further sum of £38,500 is to be spent this year and £47,200 in future years—making £650,000 in all—on the new wagon works at Darlington, and £105,200 this year on docks. This last item includes £56,500 for new coaling staiths at North Blyth.

THE following interesting figures have been given by the "Underground" authorities as to the effect the strike of trams and omnibusmen had on the tubes and the Metropolitan District Railway. Official figures show that double the normal number of passengers were carried on the Underground railways, but even then the total number of passengers dealt with by the Combine fell from 35,000,000 to 8,000,000, which suggests that more walking was done during the dispute than was realised at the time. The heaviest day on the tubes was on Wednesday, when 1,250,000 passengers were carried. Owing to the circumstances of the strike, the Underground Company was not in a position to put a single extra train into service, nor was it able to make any addition to the staff for handling the extra traffic.

Notes and Memoranda.

INVESTIGATIONS carried out by the Korean Government indicate the possibility of developing a million horse power from the Yalu River and its tributaries.

A BRIEF account is given in the *Engineering News-Record* of the emergency measures adopted to check the erosion of an American river at Shreveport. At one part of its course some 2000 discarded motor car bodies were dumped into water from 20ft. to 40ft. deep and, it is said, effectively checked the erosion.

THE Great Lake hydro-electric scheme of Tasmania is based on a catchment area in a rainy portion of the State at an elevation of 3350ft. above sea level. It is anticipated that in June, 1926, the State will have spent over £3,000,000, and this will complete the scheme whereby 69,000 horse-power will be available.

OF the 1335 million metric tons of coal produced in the principal countries of the world in 1923, the share of the United States was nearly 581 million tons. Great Britain supplied 283 million tons. World production in 1922 was 1223 million tons and 1132 million tons in 1921. The percentage of the United States of the total was 43½ in 1923, 35½ in 1922, and 40½ in 1921.

ACCORDING to the *Electrical Trailer*, power is being distributed over an area of 20 miles radius around Christchurch, N.Z., for electric tramways and lighting. Freezing works, tanneries, flour mills, woollen mills are using power. Farmers are using current to operate milking machines—of which in 1923 there were 1100 plants in operation in the Dominion, as compared with 548 in 1922. The dairy factories find electric power cleaner, handier, and more economical.

ACCORDING to Mr. Evan Jones, the Rhondda coalfield is becoming exhausted. On the other hand, he says that Llanelly has a virgin coalfield with twenty-nine seams of a total thickness of 44 yards awaiting development. A capital of £3,000,000 is required for pumping. Llanelly would then become the principal coalfield in the country, with millions of tons of steam, house and anthracite a mile from the seaboard. The Rhondda Valley coalfield is in Glamorgan, and Llanelly is in Carmarthenshire.

AT the meeting of the Yorkshire District of the Institution of Municipal and County Engineers, which was held at Rotherham on April 5th, the president, Mr. W. T. Lancashire, said that the institution was passing through its jubilee year and that the membership was well over 3000. They had now come to the conclusion that they could not allow anyone else to enter the ranks without passing an examination. Such a procedure was not only in the interests of the individual, but also of the local authority with appointments to make.

THE latest specification issued by the British Engineering Standards Association gives the dimensions of lighting and starter cables on motor cars for system pressures of 6 and 12 volts nominal, but does not deal with the composition, quality or durability of the insulating material used as the dielectric. The specification is divided into seven sections, four of these dealing with various types of lighting cables, and the remaining three being concerned with starter cables, the dimensions being given both in inches and millimetres throughout. Three types of covering are included for both classes of cable, namely:—(*a*) Braided and compounded; (*b*) metallic armoured; and (*c*) cab tire sheathing.

THE March issue of *Science Abstracts* gives a brief description of an automatic synchroniser made by Brown Boveri. It consists of a time-lag relay and a regulator. The time-lag relay consists of an aluminium disc, rotating between two electro-magnets, which winds up a thread, the end of which is fastened to a contact carried on a spring. The coils are connected to the two separate pressures in such a way that when the phases coincide, the total pressure across the coils is twice the separate pressures. If the machines are in phase long enough, the thread is wound right up and makes a contact which closes the oil-switch through a relay. If the pressures are not in phase long enough, the current in the coils is reduced and the spring unwinds the thread again. The pressure regulator inserts resistance in the coils of the time-lag relay. When the pressures are in phase the resistance is cut out, but when they are opposed the resistance is all in and the current is very small. The result is that the current in the coils rises and falls very quickly, so that the contact is closed with precision. An optical device shows whether the incoming machine is running slow or fast. Various additional refinements are described for special cases. Several diagrams of connections are given.

SINCE Major A. M. Taylor read his paper before the Institution of Electrical Engineers on his "Hexaphase" system of working cables at 150,000 volts, doubts have been thrown upon the accuracy of the basis on which the author's deductions were made, and, at the present time, there is a division of opinion among cable engineers as to whether the maximum potential gradient is, or is not, the criterion for the life of a cable. After a very careful consideration of the arguments, published by various engineers, the author is absolutely of the opinion that further knowledge of the behaviour of cables will justify the maximum gradient theory. But even if the maximum potential gradient theory proved to be wrong, the advantages claimed, viz.:—(1) Greatly reduced initial capital outlay; (2) early indication of approaching breakdown of the cable; and (3) reduced shock to the system when the fault takes place, would, it is contended, fully warrant the use of the system. It must be remembered, Major Taylor states, that it has been abundantly proved, in the case of solid insulators, that if a voltage, say, 100,000 volts, has to be impressed across a slice of insulation, the total thickness of dielectric necessary to withstand this voltage will be very much less if, for example, the 100,000 volts be broken up into three portions, each of 33,000 volts, by three slips of insulation, separated by condenser plates connected to the tappings of a transformer, rather than by attempting to put the whole voltage across a solid block of dielectric of increased thickness.

Miscellanea.

DURING the first nine months of last year, 20,509 skilled craftsmen in the metal and engineering trades left this country for various non-European countries.

A CENTRAL rescue station is in the course of erection on the Village Deep Mine property. Here it is proposed to train rescue teams from the various mines on the Rand.

ACCORDING to the American papers Professor R. H. Goddard is to make his attempt to fire a rocket from the earth to the moon very shortly. He estimates that the flight will occupy thirty-six hours.

THE new spiral-guided gas holder, in a reinforced concrete tank, which has just been completed at Dundee, is said to be the largest of its kind in this country. Its capacity is 2½ million cubic feet.

THE Committee on Arch Dam Investigation appointed by the American Engineering Foundation, has selected a site in California at which an arch dam could be built 60ft. to 100ft. high, tested repeatedly, and finally loaded to destruction.

IT is proposed to use the waters of Lake Biwa, in Japan, for supplying potable water to Osaka, Kobe and Sakai, after they have been used for power generation. The scheme includes an aqueduct capable of conveying some 343 million gallons a day.

IT is intended that the floating dock for Southampton, constructed at Walker-on-Tyne, shall leave that river for the south on the morning of April 14th. Ten tugs have been chartered to take the dock down the Tyne, while seven of them will tow it to Southampton.

AT the second International Conference of the Women's Engineering Society, which was held in Manchester on April 3rd, under the presidency of Lady Parsons, it was announced that the Society aimed at establishing a women engineers' institution on a technical administrative basis.

THE announcement is made that Dr. R. E. Stradling, M.C., M.Sc., head of the Department of Civil Engineering, Architecture and Building in the Technical College, Bradford, has been appointed Director of Research of the Building Materials and Construction Research Board of the Government Department of Scientific and Industrial Research, London.

THE Central Committee of the Miners' Welfare Fund has notified the Wigan Mining College that, subject to certain conditions being fulfilled, the sum of £25,000 has been allocated from the Fund for the development of mining education at the College. The money is intended to provide additional buildings costing £20,000, and laboratory equipment of the value of £5000.

OIL fuel bunkering prices in this country were further advanced on the 7th inst. by 5s. a ton, making the quotation for the standard on heavy grade oil £4 7s. 6d. per ton, and for Diesel engine oil £5 7s. 6d. per ton, ex wharf at oil company's installations. This is the third advance which has taken place since the close of last year, when the prices stood at £3 10s. a ton for heavy oil and £4 5s. for Diesel engine oil, the advances thus amounting to 17s. 6d. and 22s. 6d. per ton respectively.

WORK involving an outlay of £75,000 is to be undertaken at the Exeter electricity works. The Council has approved an application to extend the plant at a cost of £15,000, and the periodicity of the system is to be changed from 60 to 50 cycles. The Electricity Commissioners, it seems, have been pressing for the change in the working periodicity for some time past, but up to the present the Exeter Electricity Committee has avoided it. It has now come to the conclusion, however, that the change must be made in order to make the system conform with modern requirements and to make the city a distributing centre.

A SCHEME, proposed by Mr. J. Wibberley, the Borough Surveyor, has been adopted by the Plymouth Corporation Works Committee, and application has been made to the Ministry of Transport and to the Unemployment Grants Committee for grants towards the cost of the work. The proposal, which is designed to afford employment to large numbers of men at present out of work, is to widen Embankment-road, the main approach to the town on the east, and raise its level over a stretch of about a mile. In addition, a 16ft. promenade, planted with trees and provided with seats, is to be constructed along the banks of the Laira River, which is exceedingly picturesque at this point. The road is at present 24ft. wide, and it is proposed to extend it to 70ft., and this work, together with the raising of the level, will involve the use of many thousands of tons of filling material, the surface being estimated at 70,000 cubic yards. The stone for the foundation of the roadway will be obtained from the Corporation's own quarries at Prince Rock, and on top of the filling 12in. of limestone ballast will be laid to provide a surface for 4in. of asphalt macadam, the intention being to provide a roadway which will withstand the wear and tear of the heaviest motor traffic.

THE South Wales Electrical Power Distribution Company has had so much trouble with wireless aerials falling on its transmission lines that it became necessary for the Cardiff broadcasting station to broadcast a warning to the public regarding the improper erection of aerials. In one instance an aerial, erected over a 400-volt overhead lighting circuit, dropped on the power line. Fortunately, the safety device in the local sub-station operated and made the line dead, thus sparing the erector a severe shock. Apart from this, great inconvenience was caused to many consumers through the cessation of the supply until the cause of the trouble was found and removed. The company has attached a warning notice to lighting poles in the whole of its area. The notice states that the Cardiff broadcasting station has a plant capacity of approximately 2 horse-power and has a 350 m. wave length, whilst the South Wales Electrical Power Company has a plant capacity of approximately 80,000 horse-power and distributes at voltages up to 11,000 at a wave length of 12,000,000 m. It is also explained that aerials are erected to receive from the broadcasting station and not from the South Wales Electrical Power Company.

RESACA WAVES BREAKING ON THE PROMENADE WALLS OF RIO BAY

(*For description see page 380.*)

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DESTRUCTIVE RESACA

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*** *With this week's number is issued as a Supplement a Two-page Plate of a 350-Ton Self-propelled Floating Crane under Erection in Japan. Every number, as issued by the Publisher, contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

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By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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THE ENGINEER.

APRIL 11, 1924.

Thermodynamics and Practice.

Much discussion, as the reader will gather from a report appearing elsewhere in this issue, is once again centring around the attainment of an agreed basis for the comparison of the thermal efficiencies of internal combustion engines. Since 1903, when a committee of the Institution of Civil Engineers was appointed to inquire into the matter, it has been more or less generally the custom to evaluate the ideal efficiency of any internal combustion cycle on the assumption that the working substance is air, or more precisely a hypothetical fluid which differs from air only in so far as its specific heats remain constant at all temperatures. It was realised from the outset that this "air standard" was not altogether satisfactory, but it was defended on the ground that our knowledge of the properties of the actual working fluid in an internal combustion engine—a fluid of great complexity compared with steam—was insufficient to enable us to adopt the actual fluid as a basis for our calculations. Since 1903, however, our knowledge has been greatly increased, particularly in connection with the all-important matter of the apparent specific heats of the substance and their variation with temperature. As Mr. William Alexander pointed out in 1917, and as Mr. G. J. Wells repeated in the paper which he read on Tuesday at the Institution of Civil Engineers, three of the most reputable formulæ agree in assigning precisely the same value to the difference between the specific heat at constant pressure and that at constant volume. On the assumption that the complex working fluid is a "perfect" gas—that is to say, that it rigidly obeys Boyle's and Charles' laws—this constancy of the difference between the specific heats is all that need be established to enable us to compile tables or diagrams exhibiting the internal and total heats, the entropy, specific volume, and other properties of the fluid at all temperatures and pressures. There is therefore no reason why we should adhere any longer to the "air standard" of comparison simply on the ground that too little is known regarding the properties of the actual fluid. From the academic standpoint objections can undoubtedly be levelled against the new "gas standard." We need not, however, recapitulate them. They are not insignificant, but those who support the new standard seem to have a good defence when they claim, as they do, that it at least represents something nearer reality than does the air standard. Be that as may be, there is enough, we think, on the practical side of the matter fully to engage our attention for the present. From that point of view far too little has so far been said or written.

Precisely what practical advantage can we expect to flow from the establishment of an improved standard of comparison for the thermal efficiencies of internal combustion engines? This question, it must be admitted, cannot be readily answered with any large amount of assurance. The most prominent fact so far brought out by the discussion of the new standard is that its adoption instead of the air standard reduces the margin indicated as available for improving the efficiency of an engine working on a given cycle. An engine showing on test an actual efficiency of, say, 35 per cent. is, judged by the air standard, converting about 71 per cent. of the maximum possible amount of heat into work. Judged by the new gas standard, however, its performance represents 88 per cent. of the maximum. The new standard, it may therefore be said, is a sedative rather than a spur in the quest for improvement. In so far as the air standard gives encouragement to a pursuit of efficiencies that could never be realised, its abandonment can be welcomed. In so far as the new standard implies that it is scarcely worth while seeking improvement, its adoption would have to be regretted were it not fortunately true that in the development of prime movers thermodynamic theories have been consistently flouted or ignored by those who have wrought the chief steps towards progress. Thermodynamics was an unknown science in Watt's time. But what if it had been fully developed, what if Watt had been purely a thermodynamician and placed his sole guidance in thermodynamic theory instead of hard, plain, practical thinking? He would very emphatically never have invented the separate condenser. Impressed by Carnot's arguments, deeply convinced that the Carnot cycle represented the conditions for the attainment of maximum efficiency, he would have rejected the idea of the separate condenser as unsound and have sought to approach the ideal conditions of the Carnot cycle by continuing to condense the steam in his cylinder. Had he lived to be a contemporary of Rankine his argument would have received additional strength from the developing science of thermodynamics. The Rankine cycle makes allowance for condensation in a separate organ, and invariably shows a lower possible maximum efficiency than the Carnot cycle. With dry saturated steam at a boiler pressure of 180 lb. absolute and a condenser pressure of 1 lb. the separate condenser Rankine cycle shows over 10 per cent. less efficiency than the Carnot cycle, a reduction certainly sufficient to turn the theoretical Watt from the development of his idea. As an ardent entropist Woolf would have allowed the compound engine to remain where Hornblower had left it, for he would have been overcome by the thermodynamically irreversible changes of state that occur during the passage of the steam from one cylinder to another. Relying solely on thermodynamic first principles, we should probably never have proceeded with the idea of using superheated steam, for the gain of efficiency indicated is in general too small to justify the additional members required in the boiler plant. With steam at 180 lb. superheated to 400 deg. Cent. and a condenser pressure of 1 lb. the ideal efficiency on the Rankine cycle is 31.4 per cent., as compared with 29.2 per cent. for the same steam in the dry saturated state. Even more striking perhaps than the failure of thermodynamics to indicate the true value of superheating is its failure to reveal the disadvantages of wet steam. With the same pressures as before the Rankine cycle efficiency is reduced from 29.2 per cent. with dry saturated steam to only 28.9 per cent. when the steam at admission contains as much as one part of water in ten. The economy to be obtained by the use of dry steam is thus apparently so small as to render superfluous all precautions against priming in the boiler or condensation in the steam pipes.

In each of the instances referred to above thermodynamics can, in spite of the results of the efficiency calculations, supply a valid reason why it pays to adopt the practices mentioned. We cannot, however, shirk the fact that, second thoughts being omitted, thermodynamics—at least in the case of the steam engine—pronounces an unfavourable judgment, or a judgment less favourable than it should be, against certain methods of working and certain practices which experience has taught us are highly desirable from the point of view of economy. With these lessons before us, are we not entitled to regard its guidance as suspect, to doubt the finality of its judgment, and to demand a right of appeal to experiment? Too

often of late has a tendency been shown to reject some proposed modification of prime mover practice simply and entirely on the ground that it did not show a favourable result on the entropy diagram. How many possibilities of improvement have been cast aside for this reason, how many wild goose chases have been started because of the incompleteness and the bias of thermodynamic arguments we cannot say, but if the numbers are proportional to the opportunities they are probably great. Whether the thermodynamics of the internal combustion engine provides opportunities for false or defective deductions comparable with those provided by the thermodynamics of the steam engine, we will not for the present attempt to discuss. It is certain, however, that all discussion concerning the relative merits of the air standard and the gas standard bases of comparison must, and ought to, leave practical engineers coldly sceptical until it can be shown that the efficiencies so calculated have a real and decisive significance in practice. In the light of past history and experience there would seem to be less risk of coming to a false conclusion by adhering to the straight 100 per cent. efficiency basis than by comparing the realised figure with some ideal maximum founded on a one-sided theory and data of an arbitrary or doubtful nature. After all, changing the basis of our efficiency comparison does not increase the output of an engine by a single foot-pound. At the most it but consoles us with the knowledge that we are really less responsible for the heat wasted in our prime movers than we appear to be.

Empire Naval Defence.

The reported intention of the Australian Government to modernise its naval forces by the construction of new cruisers and submarines was confirmed last week by the Prime Minister, Mr. Bruce, in his survey of the work done at the Imperial and Economic Conferences held in London. According to the Melbourne newspapers, the scheme of defence to be laid before the Federal Parliament provides for the building of two cruisers and six ocean-going submarines, as well as for an expansion of the Commonwealth Air Force and the mounting of long-range guns in the shore batteries at Sydney, Newcastle, and other vulnerable points. In thus preparing to embark on a relatively heavy outlay in the cause of national security, Australia takes a step which will be heartily welcomed in this country. There is no denying the fact that Great Britain since the war has had to bear an unduly large share of the burden of Empire defence. Her expenditure *per capita* on naval, military, and air power is far in excess of the rate prevailing in any of the Dominions. From the latest statistics available it appears that naval defence now costs 27s. 5d. per head of population in Great Britain, as against 9s. 3d. in Australia, 4s. 6d. in New Zealand, and 1s. 2d. in Canada. This disparity seems the more irrational in view of the fact that Eastern waters are now recognised as the main strategic area so far as the British Empire is concerned. For example, the projected base at Singapore was obviously designed, in the first place, for the protection of Australia, New Zealand, and other Pacific territories, and secondly, in the interest of India, yet it is probable that about 95 per cent. of the cost would have fallen on the British taxpayer. Strategically, it is true, the Empire is a unit, the safety of any one section of it being a matter of vital concern to the whole; but for this very reason the cost of defence ought to be distributed more evenly among the component States. Since the war, however, there has been a tendency in the Dominions to ignore their responsibility in this respect. Canada led the way by virtually scrapping her fleet, which now consists of two destroyers. Sweeping reductions were also effected in the Royal Australian Navy, of which only a skeleton force of three light cruisers and three destroyers is at present in commission.

But judging from Mr. Bruce's recent statement of policy, Australia, at all events, is now making ready to play a worthier part in the common task of defence. Her new cruisers, which presumably will be up to the full standard of size and power permissible under the Washington Treaty, will cost about £1,750,000 apiece; the six ocean submarines are priced at from £250,000 to £300,000 each, and a further large sum will be absorbed by Air Force and coast defence improvements. One of the two cruisers is to be ordered in this country, and will therefore be a welcome addition to the meagre sum of work afforded to private shipyards by the Admiralty programme; the other is to be laid down at Cockatoo Island Dockyard, Sydney, which has already built two cruisers for Australian service. Where the six submarines are to be constructed has not yet been made known. Owing to the phenomenal progress which naval design has made in the last ten years, the greater part of the Australian fleet is already obsolescent. The battle-cruiser Australia, which was built at the charge of the Federal Government, following the naval crisis of 1909, and completed at Clydebank in 1913, is among the ships condemned by the Treaty. This deprives the Commonwealth Navy of its only capital ship. It has four light cruisers modelled after the British "Dublin" class, which would still be efficient vessels but for the remarkable advance in speed which has characterised post-war construction of the cruiser type. Whereas every foreign cruising ship built since the war is designed for a speed of 33 knots or more, the Sydney and her consorts, Melbourne, Brisbane, and Adelaide, can steam only 25 knots, though the last-named vessel was completed as recently as 1922. All these ships, moreover, are coal-burners. The Adelaide, by the way, is to join the Special Service Squadron on its departure from Australian waters and accompany the battle-cruisers on their homeward voyage to England. As the other three ships were launched from nine to twelve years ago and all saw hard service during the war, they cannot any longer be rated as fully effective. In estimating the "life" of a light cruiser, the Admiralty, according to a statement in Parliament on March 3rd, counts one year's war service as equivalent to two years' peace service, and since the efficient "life" of such a vessel is reckoned as fifteen years, it will be evident that most of these Australian ships have already exceeded their span of useful existence. Indeed, the only really modern craft in the R.A.N. to-day are the flotilla leader Anzac and five destroyers presented by the British Government in 1919. Six large submarines of the "J" class were also presented to the Commonwealth, and were, so far as is known, efficient in every respect, yet they are reported to have been scrapped last year in the interests of economy. Apart from base facilities, Australia's most urgent need is for cruising ships and submarines, which would be equally valuable for trade protection and coast defence. It is greatly to be regretted that three cruisers were dropped from the current British programme, but the deficit will be partly made up by the new Australian ships. Should the New Zealand authorities decide to proceed this year with their plan of ordering one new cruiser, the full quota of eight Imperial ships will be forthcoming. These represent only the first instalment of the Admiralty's programme of replacement, which calls for the construction of fifty-two cruisers during the next ten years; but judging from Australia's action the Dominions may participate in this work to a greater extent than could have been hoped for a few months ago.

We are not, however, among those who hold that the interest of the Overseas States in Empire naval defence will be stimulated most effectively by a display of indifference on the part of the Home Government, such as is implied by the decision to shelve the Singapore scheme. While it may be true that Australia's resolve to build more ships is traceable to this decision, which may also spur New Zealand to greater efforts in the same direction, we cannot believe the cause of Imperial unity will benefit in the long run by what can only be described as a dereliction of duty on the part of the British Government. There is, happily, no immediate menace to the Empire in the Pacific Ocean. On the other hand, it were surely idle to pretend that our naval policy in the post-war era has not been influenced mainly by developments in the Far East. The British Navy exists to defend the British Empire as a whole, and unless it is competent to discharge that function it loses its *raison d'être*. The postponement of the Singapore plan may be a fine "moral gesture," but at the same time it is undoubtedly an act of political unwisdom, as the heated comment from certain of the Dominions painfully reminds us. We have already pointed out that the scheme was, in essence, purely technical, and had nothing to do with the "spirit of the Washington Treaty" or any other abstract consideration. The point at issue is simply whether an overseas base of great strategic importance is, or is not, to be made accessible to our modern battle fleet. If it is not, then the traditional claim of the British Navy—a claim founded upon the soundest principles of strategy—that it is able to go anywhere and do anything, will cease to be true. By refusing to provide accommodation at Singapore for our best fighting ships we are, in effect, denying the Navy the power to exert its strength anywhere outside European waters, because only there are to be found docks commodious enough to take the ships in question. At the same time the policy of creating oil-fueling stations along the route to the Far East is apparently to be maintained, though why these stations should be necessary when the absence of a terminal base will preclude the sending of capital ships to any destination beyond the Mediterranean, is a riddle we are unable to solve. So far from our having given a lead to Australia by postponing the Singapore scheme, we are inclined to think that she has given a lead to us by deciding to reinforce her fleet. We remain confident, however, that the present British Government's short-sighted decision in this matter will sooner or later be reversed, and the development of this indispensable fleet base be continued at an accelerated rate.

Electricity Supply.

In the course of his admirable presidential address to the Institution of Mechanical Engineers, Mr. W. H. Patchell referred to the extensive use of electricity in America, and expressed the opinion that it was due to the skill and zeal of those who handle the sales departments of the electricity supply undertakings. Almost every engineer who visits America for the purpose of studying electricity supply returns to this country dissatisfied with the way in which the business side of our undertakings is managed. Over and over again the need for more efficient salesmanship has been emphasised by progressive men who want to see the supply business in this country flourish. It was stated some time ago in an American publication of repute that the world's consumption of electrical energy for the year 1920 was 100,000 million kelvins or Board of Trade units. On the list of countries consuming this huge amount of electrical energy, America comes first, and accounted for no less than one-half of the world's consumption, whilst Germany came second. Incidentally, it was shown that at that date only 5 per cent. of the world's water resources had been developed. The units consumed annually per head of population in the various countries at that time were:—Switzerland, 700; Canada, 612; Norway, 493; United States, 472; Sweden, 364; France, 147; and the United Kingdom, 139. These figures were recently given by Mr. S. L. Pearce, in his presidential address to the North-Western Section of the Junior Institution of Engineers, and although they relate to the conditions existing four years ago, they are, nevertheless, instructive. In view of the intensely developed character of this country, it is hardly satisfactory to find it at the bottom of the list and inferior, so far as the development of electricity is concerned, to France and the United States. Needless to say, the development of electricity supply is a matter of very great importance to engineering manufacturers, for unless a good demand for current exists the manufacturing side of the electrical industry must obviously suffer.

The management of the business side of our electricity supply undertakings must be improved if this country is to show better results as regards the units consumed per head of population. We have never quite understood how it is that the commercial management of our electricity supply undertakings has been left very largely to engineers who have never had a business training. Manufacturing firms do not, as a rule, expect the technical members of the staff to secure orders. Turbine designers are not expected to sell turbines or boiler designers to sell boilers—or, in fact, to have anything to do with the sales department. But on the supply side of the electrical industry, an engineer without any commercial instincts or ability is frequently placed at the head of affairs, frequently even without the assistance of a good commercial man. Has not the time come when every supply undertaking of importance should have a proper commercial department with a thoroughly competent commercial man at the head? As a general rule, engineers are too deeply engaged in other affairs to take much interest in commercial matters, apart from those relating to fuel economy and capital costs. We are aware, of course, that there are in this country electricity supply undertakings which have built up big and profitable loads under the management of their engineers; but they are the exception rather than the rule. If all engineers were as enthusiastic about increasing the domestic and industrial loads as, say, Mr. J. W. Beauchamp, there is not much

doubt that the consumption of electricity in this country would increase by leaps and bounds. Speaking generally, however, the average engineer is not interested in the job of persuading butchers to use electrically driven sausage machines, or in the task of getting housewives to use electric cookers. Mr. Patchell's plea for more activity on the commercial side of electricity supply undertakings is therefore a sound one. For a very long time past it has been realised that the lack of commercial ability and zeal on the supply side of the electrical industry has been a very serious drawback. It is true that within recent years matters have considerably improved. The formation of the Electrical Development Association at the close of the war was a step in the right direction. An organisation such as it cannot, however, do all the work that has to be done in connection with making electricity popular. Progress, as Mr. Patchell has said, depends mainly on the skill and zeal of those who handle the electric supply undertakings. In this respect we can take a lesson from the Americans, but we are not so sure that it will be wise to follow their technical developments too closely. The American policy now is to build very large generating stations, equipped with very large generating units and boilers. It does not follow that this is the best policy for us to pursue. The huge power station does not, as we have often pointed out, necessarily result in a universal supply of cheap current, which, after all, is what is mostly needed in this country.

Mr. Patchell showed that in two score years 1881–1923, very great progress was made in the design of generating units, and in the use of high pressures, and he asked, What of the next twenty years? An answer to this question cannot, unfortunately, be provided, but it is well within the range of possibility that in twenty years' time, and perhaps long before, we shall be able to generate electricity cheaply without the use of boilers. Towards the end of his address Mr. Patchell mentioned that a 5000-kilowatt gas turbine was practically complete and ready for running, and that an oil turbine had also been built. Before constructing huge steam stations, in imitation of American practice, it is well to endeavour to picture the future, for otherwise we may find when these new stations are complete that something very much better has come into existence, and that our newly equipped stations are already obsolete. We suggest that as far as possible new demands for power should be met by extending, improving and linking-up existing stations, rather than by building other stations with enormous capacities. America, it is to be remembered, is the home of gigantic undertakings, and it does not necessarily follow that American engineering practice is always the best or most suitable for the conditions prevailing in this country. The station of moderate capacity will meet our present requirements, and leave us with greater freedom to take advantage at once of such developments as seem to be imminent, than if we owned those vast units which are, it seems, suited to American conditions.

Literature.

Coal Tar Distillation and the Working Up of Tar Products. By Arthur R. Warnes. Third edition. Pp. xv. + 511. London: Ernest Benn, Limited. 1923. Price, 45s. net.

Those who are familiar with the first two editions of "Coal Tar Distillation" may be led into thinking that another edition will contain insufficient new information to warrant their giving it attention; but in reality the author has taken his earlier edition as a basis, and from it produced a very complete and concise treatise on the production of coal tar, which should be of use not only to the chemical engineer and coal tar chemist, but to anyone who is interested in this industry. It is written essentially from the technical standpoint, but the author has succeeded in making it intelligible even to those who are not directly concerned with the technicalities of the operations he discusses.

Throughout the work, the aim of Mr. Warnes has been to deal thoroughly with his subject, and he has begun well by writing two extra chapters dealing with the general properties of coal in order that the subject of its products may be understood more fully. In Chapter I. the nature, occurrence and geology of coal are outlined, unnecessary detail being omitted. Chapter II. is longer, and deals with the classification and constitution of coals from the point of view of the plant cells entering into their formation and from the chemical composition of their carbonised products. Chapter III., which deals with the composition of coal tar, contains authoritative information on the various types of coal tar, their mode of formation, composition, and their distillation products. Numerous tables are given and statements are, wherever possible, confirmed by results of experiments. Coke-oven, blast-furnace, water-gas, lignite and carbo-coal tars are all dealt with and their characteristics considered. Chapter IV. deals with the lay-out of tar works, and a number of "ideal sites" for the erection of a tar distillery are given. Although an ideal site is very rarely a possibility, these notes are, nevertheless, of value. Many practical suggestions are offered, and notwithstanding the fact that a distillery on the lines suggested by the author would be an expensive proposition, it would be entirely self-supporting. Chapter V. deals with the methods of storing the crude tar as received from the gasworks, whilst Chapters VI. to VIII. describe the plant used in tar distillation. Numerous diagrams and folders are given, together with a number of photographic illustrations.

The author has so arranged his work that a description of the plant employed in each process precedes that of the actual operations. Hence, Chapter IX. is devoted to the distillation of tar, the methods of of working the plant being very well described. The relative merits of continuous and intermittent distillation are discussed. Chapters X. to XVIII. deal with the recovery of carbolic acid, cresylic acid, benzoles, naphthas and their rectification, pyridine, crude naphthalene and anthracene. The chemical and physical properties of the products are well given, and these chapters, which cover some 150 pages, form a comprehensive section on the properties of these substances. Chapters XIX. and XX. deal respectively with pitch and creosote, their uses receiving more attention than in the case of the products above. Chapter XXI., dealing with gas stripping, is a long one, but since the process is one which has developed out of the unprecedented demand for toluene during the war, information thereupon has not previously been available in a collected form. Chapter XXII. is entitled "Tar-Works Tests," and contains as much information in a condensed form as might be found in a separate treatise. Physical and chemical tests are dealt with in conjunction with the standard specifications for tar products, which generally insist upon a standard method of testing. The work is concluded by an appendix, in which are printed the Factory Acts relating to Tar Distilleries.

The author is to be congratulated on having produced a book which may be justly considered a standard treatise on coal tar. For a work to be standard it must be authoritative, and since references—of which there are some 350 in the text—have been given wherever possible, this work may claim to be so. In addition, a useful bibliography is included in each chapter. In a work of this kind, however, it is doubtful whether a section of trade advertisements adds to the general tone of the work.

Merchant Ship Types: Being a Survey of the Various Units Engaged in the Water Transport of People and Merchandise. By A. C. Hardy, B.Sc. London: Chapman and Hall, Limited. 15s. net.

The author of this handbook is a naval architect by profession, and he has written it with the evident idea of helping the tyro over the rough road of first principles which he himself has had to tread. That is a task which would daunt most men, not only because there is such a vast field to be covered, but because the subject appears to be so delightfully easy to the man who has the knowledge at his finger-tips that it is not until he has put in a very great amount of work that he sees how difficult it is to keep things in their proper proportion and to cover the ground in the way it should be covered. Mr. Hardy must be congratulated on the success with which he has tackled an awkward problem. But at the same time it would appear that he has only dimly realised the difficulties of his task, for he has begun by splitting up the power tonnage of the world into three groups—ocean-going, sea-going and coastal, and subsidiary types. As there are many ships disobliging enough to refuse to fall into any of these groups, the classification now and again fails, and throughout the book there is a tendency to "back and fill" when border-line cases are met with.

In the matter of proportion, the book appears to reflect the personal tastes of the author rather than the coolly considered judgment of the student, the section on icebreakers and train ferries, for instance, being over two-thirds as long as that on the fast ocean liners. Similarly, the writer is apt to forget that he is supposed to be writing for tyros, and in the history of oil tankers, he talks about expansion tanks pages before he has given the reader the least information as to what they are. For the same reason his index needs revision. Not only is it split up in a manner, which may be excellent for a man who knows just where to look for his material though it may be worrying to the novice, but what has been inserted is often very puzzling. For instance, a reader who wants to know all about an awning deck ship is not likely to look for her under the letter "S," where such steamers appear under "Spar and Awning Deck Steamers." Instances of this kind may be multiplied many times.

But these are all the objections, and against them we may set the merits of the volume. It is a book which is very badly needed, and it gives an enormous mass of information in a remarkably readable form, while the illustrations are excellent and explain the text very well indeed. The writer obviously loves his subject and writes as only an enthusiast can. A little more care over the sub-editing and checking would have made it a really noteworthy book in its line; and even as it is it should enjoy a very gratifying measure of success.

Mechanical Road Transport. By C. G. Conradi. London: Macdonald and Evans, 29, Essex-street, W.C. 2. Price 21s. net.

Whereas the literature designed for the assistance of private car owners is voluminous, that bearing on the commercial aspects of mechanical road transport is scanty and scattered. Those who like ourselves recall with pleasure Mr. Conradi's paper, "Mechanical Road Traction," read before the Institution of Mechanical Engineers in November, 1919, will, we think, agree that few are better qualified to rectify the omission than he. In this work, largely a development of his paper, he has attained a praiseworthy measure of success in dealing with the subject, although it is not to be thought that in a single volume of something less than four hundred pages he has contrived to cover all the ground open to him, nor to treat each section of it with equal thoroughness.

The work, it should be made clear, is far from being exclusively of engineering interest. Mr. Conradi is no doubt concerned with the mechanical and electrical details of steam, petrol, electric, and petrol-electric road vehicles, tramways, trackless trams, road trains and omnibuses. But his outlook on the strictly engineering aspects of his subject is tempered largely by commercial considerations, and while the engineer interested in the technical design of road vehicles of all kinds will certainly derive much assistance from his pages, it is primarily to those concerned with the planning and operation of road transport services that his book will appeal.

The author treats his subject with very even-handed justice, neither seeking to minimise the advantages of other forms of transport nor to exalt one type of road transport to the discredit of others. The relative merits of steam, petrol and electric vehicles, for instance, are discussed without the slightest trace of partisanship. He is not, however, afraid to express his opinions on debatable points, and as these opinions are derived from a long experience of every kind of transport work, they will no doubt be accorded the weight which they deserve.

Apart from the more or less technical chapters in which the author deals with the design of road vehicles and its influence upon their operation, there are several general chapters of particular interest. In one such chapter Mr. Conradi discusses roads and road resistance, and in a closely succeeding one the power required for traction. Fuels and tires are dealt with in two separate chapters, while labour and time-saving devices and working costs are considered elsewhere in a very instructive manner. In a series of no less than eighteen appendices much valuable information relating to the legislative aspect of road transport and cognate matters has been gathered together.

BOOKS RECEIVED.

Scottish Road Conference, 1924. Papers submitted to the Conference and report of the proceedings.

Directory of Paper Makers of the United Kingdom, 1924. London: Marchant, Singer and Co., 47, St. Mary-axe, E.C. 3. Price 5s.

Institution of Mechanical Engineers: Vol. II., 1923, *Proceedings*. London: Published by the Institution, Storey's-gate, S.W. 1.

Fuel Economy in Steam Plants. By Arthur Grounds. London: Sir Isaac Pitman and Sons, Parker-street, Kingsway, W.C. 2. Price 5s. net.

Theory and Practice of Mine Ventilation. By Thomas Bryson. London: Edward Arnold and Co., 41 and 43, Maddox-street, W. 1. Price 8s. 6d. net.

Chamber of Shipping of the United Kingdom: Annual Report, 1923–1924. London: Chamber of Shipping of the United Kingdom, 28, St. Mary-axe, E.C. 3.

Moss from a Rolling Stone. By E. A. Brayley Hodgetts. London: J. M. Dent and Sons, Limited, Aldine House Bedford-street, W.C. 2. Price 10s. 6d. net.

Elementary Applied Mechanics. By T. Alexander and A. W. Thompson. London: Macmillan and Co., Limited, 110, St. Martin's-street, W.C. 2. Price 15s. net.

Report on the Progress and Condition of the United States National Museum for the Year ending June 30th, 1923. U.S.A.: Government Printing Office, Washington.

Official Chemical Appointments. Fifth edition, revised and enlarged. London: The Institute of Chemistry of Great Britain and Ireland, 30, Russell-square, W.C. 1.

Seaborne Trade: Vol. III., The Period of Unrestricted Submarine Warfare. By C. E. Fayle. London: John Murray, 50A, Albemarle-street, W. 1. Price 21s. net.

The Engineers' Year Book for 1924. Compiled and edited by H. R. Kempe and W. Hanneford Smith. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 30s. net.

International Air Congress, London, 1923, *Report*. Edited by Lieutenant-Colonel W. Lockwood Marsh. London: International Air Congress, 7, Albemarle-street, W. 1. Price 25s. net.

A New Cement Works on the Humber.

No. III.*

THE COAL HANDLING, DRYING AND GRINDING PLANT.

The kilns are fired with powdered coal, and the pulverising is done on the site. The arrangements as we saw them were not quite as they now exist, but we propose to describe them in their final state and to indicate in what manner the equipment we saw differed from it. The coal plant was designed to utilise run-of-mine or slack coal, which will be brought on to the site in standard gauge drop bottom wagons, which will discharge it into a receiving hopper constructed immediately below the railway siding. From the hopper the coal will pass through a set of crushers designed to deal with about 30 tons per hour, reducing the coal to pieces not greater than 1in. cube, the crushed fuel being then lifted by an inclined bucket elevator and delivered into a rectangular reinforced concrete storage bin or silo, which is designed to hold about 1000 tons. At the time of our inspection of the works, although the underground hopper was completed, neither the crushers nor the elevator were fixed, nor was the silo completed, the fact being that the company, when it had got its works into such a state of forwardness that cement could be made without excessive labour costs, decided very wisely to begin manufacture and leave till a more favourable time the completion of non-essential, though by no means useless, portions of the equipment. It took this step when prices of materials were a good deal higher than they now are, and it is now proceeding with the completion works. At first, therefore, temporary expedients were resorted to. The coal, as received, was dumped in heaps at the side of the siding, and was thereafter handled by a travelling jib crane furnished with a bucket grab. We understand, however, that the complete coal handling plant has now been installed and is working satisfactorily.

Arranged underneath the coal storage silos is what is termed a torpedo conveyor, which is a comparatively novel apparatus of the horizontal reciprocating tray type, but is different both in construction and operation from the shaking conveyor. The latter is usually supported from below by means of wood or steel laths, and it receives a comparatively rapid reciprocating or shaking motion from a crank or excentric driving gear. The torpedo conveyor, on the other hand, is not directly actuated by the driving gear, but is hung by means of links fitted with ball bearings from a framework arranged vertically over it. This framework, which runs on rollers, is given, by means of a revolving cranked axle, a slow reciprocating movement of about 60 strokes per minute, and, as it moves forward, it takes with it the depending tray on to which the coal is delivered. Just before the end of the forward stroke is reached, an air brake—which takes the form of a pneumatic cylinder, the rear end of which is fixed, while the front end of its piston-rod is attached to the underside of the depending tray—comes into action, with the result that, though the forward progress of the tray itself is checked, the coal continues to travel forward by its own momentum, so that, gradually, coal put on the tray at one end is propelled to the other end of the tray. The length of the conveyor, which was one of the few things in the works which were not made in this country, it having been obtained from France, is 53ft., and eventually it will be fed from six automatic feeders depending from the bottoms of the coal silo. On the occasion of our inspection the coal was being dumped on the conveyor at one end from wheel barrows, for, as a trial was in progress, it was necessary to ascertain the weight of the fuel consumed. Notwithstanding the fact that the coal was being shot on to the conveyor in heaps, the action of the apparatus was such that by the time the end of the travel was reached the heaps had got so completely levelled out that the delivery was in a quite even stream. The apparatus works gently and with practically no jar, so that it does not require heavy foundations. We understand that it can even be employed for conveying such impalpable material as ground cement without the necessity of providing a covering because no appreciable quantity of dust is produced.

FIG. 12—CLINKER GRINDING MILLS

The delivery from the conveyor, which, it may be explained, is at ground level, is into the boot of a vertical steel-encased elevator of about 65ft. centres, which lifts the coal and delivers it into a receiving hopper over a rotary dryer which is driven by a 10 horse-power motor. Eventually there will be two dryers, but at present only one has been installed, and it is capable of dealing with sufficient coal for the two rotary kilns. The dryer is a riveted steel-plate cylinder, 50ft. long and 5ft. in diameter, provided with tires carried on rollers and revolved in the same manner as are the kilns. It is encased in brickwork and is slightly inclined to the horizontal, so that coal fed in at the top tends to make its way to the lower end. The heat is applied by means of a separate coal-fired furnace, the hot gases being first passed all round the outside of the cylinder and then back inside. The cylinder is furnished inside with ribs which lift the coal and let it fall through the gases. The gases, after leaving the cylinder, pass to a chimney and no fan is used. The dried coal on being discharged from the cylinder falls into a worm conveyor, by means of which it is taken underground into the coal mill house which, as can be seen from the plan, is an entirely detached building. On reaching it the coal is taken up by an elevator into steel plate hoppers arranged above the grinding mills, which are of the combination tube type, and are of similar construction to those used for grinding the chalk, being fed in the usual way by automatic feed tables. Each mill is driven through gearing by a 150 horse-power motor. Eventually there are to be three mills, but at present only two have been installed, each mill being of such capacity that it will grind sufficient coal to feed one of the rotary kilns to such a fineness that 90 per cent. of the powder will pass through a standard testing sieve having 180 holes per lineal inch. The powdered coal as it leaves the grinding mill falls into a conveyor, which delivers it into the boot of a dust-proof elevator which, in its turn, lifts it and delivers it by means of a distributing conveyor into either one or other of three—only two of them were in position when we visited the works—steel-plate hoppers arranged above the kiln firing platform. Each hopper is designed to hold enough powdered coal for six hours' working of one kiln.

Should the elevating equipment lift more coal than is needed, the conveyor, which is prolonged for the purpose, can deliver the surplus to a large reinforced concrete silo, which measures 30ft. in diameter by 41ft. high, which is capable of holding some 300 tons, and which has been erected alongside the firing platform. The silo is divided into four compartments, and is furnished with automatic extracting screws so that each compartment can be filled and emptied separately. It is not ordinarily intended, of course, to store so much powdered coal as 300 tons, but the reserve capacity has been provided for use in emergency. Normally the silo will only be drawn upon for the supply of fuel for the kilns during week-ends when the coal grinding plant is shut down. The conveyors are arranged in such a manner that the powdered coal can be kept in continuous circulation through the silo to prevent any possibility of spontaneous combustion.

The powdered coal from the hoppers over the operators' platform is fed into the kiln in each case by a twin spiral feeder, the delivery from which is into an injector-shaped inlet fitted in the delivery pipe of a high-pressure motor-driven fan, the arrangement being such that the coal falls into the air pipe and is carried forward to the firing nozzle in the hood of the kiln. The spiral feeder is driven by a variable-speed motor, so that the quantity of fuel delivered to the kiln can be regulated as desired. The fans draw their supply of air through the coolers by means of suction pipes taken from the chambers connecting the outlets of the kilns and the inlets of the coolers. This arrangement, of course, serves the double purpose of cooling the clinker, and of assisting the combustion, thereby saving fuel by using preheated air in the coal blast pipe. The whole equipment is standard practice, and does not call for any special comment.

FIG. 13—DELIVERY ENDS OF THE CLINKER COOLERS

CLINKER COOLING AND GRINDING.

The burnt clinker coming from the kilns falls by gravity to rotary coolers, Fig. 13. There will, eventually, be three coolers, one to each kiln, but at present, of course, there are only two. Each is 6ft. in diameter and 60ft. long, and is mounted and revolved in exactly the same manner as are the kilns. In the case of the Humber Company's plant the site and conditions are such that it has been possible—and was actually preferable—to place them in a line with the

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kilns and with their delivery ends facing in the same direction as the delivery ends of the kilns. In this way the direction of progress of raw materials is practically continuous from the point where the chalk and clay enter the factory until the burnt clinker falls from the coolers. As a matter of fact, the process is continued, as will be shown later, until the cement is actually bagged for dispatch, the aims of the designers—with a view to saving labour and working costs—having been for the raw materials to enter the factory at one end of the site and the finished cement to leave it at the other end without having to be taken back on its tracks.

The coolers are provided internally with steel scoops, which lift the clinker as the cylinder revolves

FIG. 14—MOTORS FOR DRIVING CLINKER GRINDING MILLS

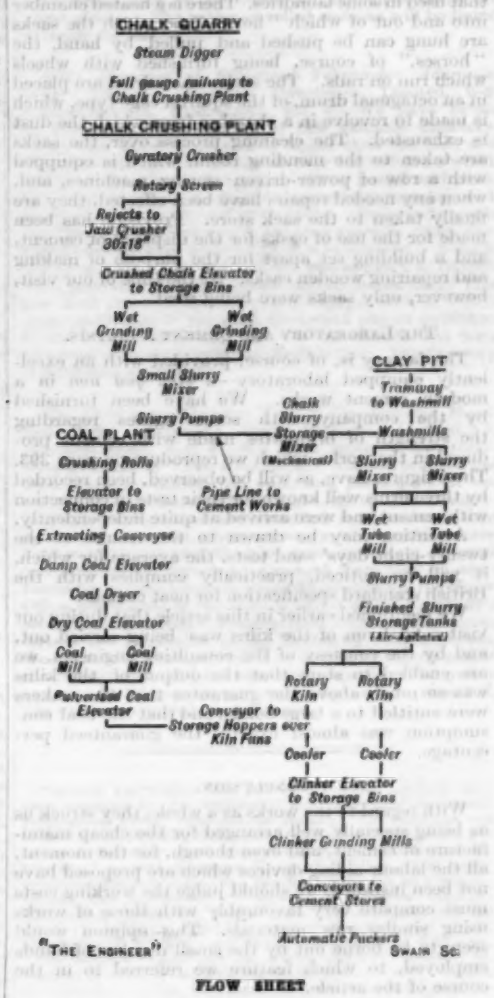
and drop it in cascades through the stream of air which is continuously flowing through the tube. Just before the clinker issues from the cooler it is sprayed by a small jet of water. When the works are completely equipped, the clinker, as it issues from the coolers, will fall on to a torpedo conveyor of similar construction to that which has already been described in connection with the coal plant. This conveyor will deliver it into the boot of a continuous bucket elevator, having a capacity of some 30 tons per hour, which will discharge into another torpedo conveyor, which will be taken over reinforced concrete silos constructed over the cement grinding mills and extended so as, if necessary, to deliver the clinker on to a bulk storage ground. At present, however, these mechanical arrangements have not been installed and the clinker simply falls from the coolers into brick-lined pits, from which it is lifted by means of a jib crane provided with a bucket grab, which in turn discharges it into small tip wagons, the latter being pushed, one by one, on to a weighbridge before receiving its load. The wagons or trucks are then run on a narrow gauge line on a raised staging, one branch of the line extending to just above the hoppers of the grinding mills, and the other over the storage ground. At present the gypsum for regulating the setting time of the cement is added by hand, but when the necessary plant is in position it will be dealt with in the following manner. The mineral arriving by rail in lumps will be fed to a small jaw crusher, and will then be lifted by an elevator to a steel hopper having three compartments. Under each compartment will be fixed a small rotary table feeder, the discharge of which can be accurately adjusted. The delivery will be on to the feed tables for the cement grinders. As much as 60 tons of gypsum per week will have to be handled when the factory is in full operation.

The clinker is ground in three Edgar Allen "Stag" combination tube mills, which are practically identical with those already described, and one of them is driven by a 500 horse-power motor, while the other two, which are smaller, are each designed to grind from 8 to 10 tons of cement per hour to a fineness considerably greater than that stipulated in the British standard specification. As a matter of fact, we understood that at the time of our visit the fineness was such that only 5 per cent. remained on a standard 180 by 180 mesh sieve. Each of the two smaller mills is driven through a train of gearing by a 400 horse-power motor. The clinker from the silos is extracted by automatic rotary tables of the usual type and is fed into the mills by means of special spiral feeders. Views of the clinker grinders and of their driving motors are given in Figs. 12 and 14.

THE CEMENT STORAGE AND DISPATCH.

The grinding mills are in a direct line with the kilns and the coolers, and the ground cement discharged from them is again taken forward in a straight line by means of an elevator and conveyors. A concrete raft foundation for a cement store, which is to have a capacity of several thousand tons, is already in position, and although the building is not yet erected, we may say that the silos which it will support will be arranged in two rows, beneath each of which will travel a special portable extractor. It will be possible to attach these portable extractors, which will be driven by small electric motors, to any one of numerous hopper mouths beneath the various compartments of the silos. They will then take the cement from the silo and deliver it into a long spiral conveyor running the full length of the building between the two lines of silos. The advantage claimed for this arrangement of plant is that the silos can be divided into a considerable number of compartments without having to incur the capital expenditure involved in installing a similar number of extractors. It will thus be possible to store different batches of cement in separate compartments.

For the time being the cement is being stored in bulk in a building constructed for the most part out of material which was used during the war for seaplane sheds at the naval aerodrome at Brough. The cement is brought into the building at a height of some 20ft. or so, and is taken down along its centre, depending spouts being arranged at intervals in its length so that the cement can be delivered up into sections by means of wooden partitions. There are also longitudinal partitions so as to leave a gangway down each side of the central space. Below the floor in each gangway is a spiral conveyor, and each division of the floor is in communication with the conveyors on each side by means of shoots. When it is required to draw upon any particular division its



FLOW SHEET

shoots are opened. A certain amount of the cement will then pass into the conveyors by gravity, and the rest is helped on its way or actually shovelled towards the shoots by men. The conveyors both deliver at the same end of the building, and there are two elevators which lift the cement into hoppers over two weighing and sacking machines, one on each side of the building, which has a railway siding and platform on each side of it. The weighing and sacking machines were supplied by the Bates Valve Bag Company, of Chicago. With them the mouths of the bags are tied before being filled, and the filling is carried out through an opening in the bottom of the bag, which is so formed that it is self-closing when the weight of the cement comes on it. By these means the cement is weighed and the bags are filled automatically. For the time being, when the filling process is completed the bags are wheeled away on hand barrows into covered railway vans or trucks drawn up beside the platform. Eventually, however, there is also to be a travelling band by means of which the bags can be transported to the filled bag store. We understand that one man

Independent Tests of Humber Brand of Portland Cement.

Test.	Requirements of the British standard specification.	Messrs. H. Faija and Co.		Mr. R. H. H. Stanger.		Messrs. Davey and Bell.	
		Delivery.	Grinding.	Delivery.	Grinding.	Delivery.	Grinding.
	Per sq. in. minima.	lb.	lb.	lb.	lb.	lb.	lb.
Tensile strain at seven days—							
Neat cement	450 lb.	846	850	847	840	746	742
Three parts standard sand, one part "Humber" cement	200 lb.	430	438	383	381	423	431
Tensile strain at twenty-eight days—							
Neat cement	530 lb.	917	919	960	948	862	870
Three parts standard sand, one part "Humber" cement	250 lb.	537	532	475	469	579	586
Residue on 180 sieve	14% allowed	4.68%	4.56%	4.7%	4.8%	6.35%	6.63%
Chatelier test	10 mm. expans'n all'w'd	0.8 mm.	0.9 mm.	1.15 mm.	1.10 mm.	0.7 mm.	0.6 mm.
Setting time—							
Initial		97 min.	91 min.	106 min.	119 min.	118 min.	112 min.
Final		3 h. 43 min.	3 h. 10 min.	3 h. 34 min.	3 h. 47 min.	4 h. 39 min.	4 h. 37 min.

can, without difficulty, operate a sack-filling machine dealing with 30 tons per hour.

The Sack Drying, Cleaning and Mending Plant.

A necessary adjunct to the use of sacks is a sack drying, cleaning and mending plant. Sacks returned to the factory are always dirty and are frequently wet and torn. They must be dried before anything can be done with them. The drying plant is very similar to that used in some laundries. There is a heated chamber into and out of which "horses" on which the sacks are hung can be pushed and pulled by hand, the "horses," of course, being furnished with wheels which run on rails. The sacks when dried are placed in an octagonal drum, of the squirrel cage type, which is made to revolve in a chamber from which the dust is exhausted. The cleaning process over, the sacks are taken to the mending room, which is equipped with a row of power-driven sewing machines, and, when any needed repairs have been effected, they are finally taken to the sack store. Provision has been made for the use of casks for the dispatch of cement, and a building set apart for the purpose of making and repairing wooden casks. At the time of our visit, however, only sacks were being used.

The Laboratory and Cement Analysis.

The factory is, of course, provided with an excellently equipped laboratory—a *sine qud non* in a modern cement works. We have been furnished by the company with some figures regarding the strength of briquettes made with cement produced in the works, which we reproduce on page 393. These figures have, as will be observed, been recorded by three firms well known for their tests in connection with cement and were arrived at quite independently.

Attention may be drawn to the results of the twenty-eight days' sand tests, the average for which, it will be noticed, practically complies with the British standard specification for neat cement.

We mentioned earlier in this article that during our visit a trial run of the kilns was being carried out, and by the courtesy of the consulting engineers, we are enabled to state that the output of the kilns was so much above the guarantee that the makers were entitled to a large bonus, and that the coal consumption was almost exactly the guaranteed percentage.

Conclusion.

With regard to the works as a whole, they struck us as being specially well arranged for the cheap manufacture of cement, and even though, for the moment, all the labour-aiding devices which are proposed have not been installed, we should judge the working costs must compare very favourably with those of works using similar raw materials. This opinion would seem to be borne out by the small number of hands employed, to which feature we referred to in the course of the article.

Efficiency Standards for Internal Combustion Engines.

On Tuesday evening the Committee on Tabulating the Results of Heat Engine and Boiler Trials held a meeting at the Institution of Civil Engineers in London for the purpose of discussing standards of comparison for the thermal efficiency of internal combustion engines. The Heat Engine and Boiler Trials Committee is a body jointly appointed by the Institutions of Civil, Mechanical, and Electrical Engineers, the Institutions of Naval Architects and Marine Engineers, the North-East Coast and the Scottish Institutions of Engineers and Shipbuilders, the Institute of Chemistry, the British Electrical and Allied Manufacturers' Association, and the British Engineers' Association.

Tuesday's proceedings were opened by the presentation of a paper by Mr. G. James Wells, of the East London College, the full title of which was "Standards of Comparison in Connection with the Thermal Efficiency of Internal Combustion Engines." An officially prepared summary of Mr. Wells' paper appeared in our last issue, but it may perhaps prove useful if we turn again to it in order to assist the reader to understand the discussion.

In 1903 the Institution of Civil Engineers appointed a committee to consider the possibility of determining a standard for computing the ideal efficiency of internal combustion engines. That committee reported some two years later in favour of what is now known as the "air standard." The procedure suggested was that the ideal efficiency for any cycle of operations was to be arrived at on the assumptions that the working fluid possessed the properties of air, except that its specific heats were to be regarded as constant at all temperatures and pressures, and that this air went through the same cycle of pressure as the actual fluid. It was realised that the use of air at constant specific heat might lead to the introduction of error and discrepancy; but at that date too little was known concerning the properties of the actual working fluid—even though it were assumed to be constant with all types of fuel—to permit a nearer approach to reality to be made.

Mr. Wells' paper is very largely merely a repetition of a paper by Mr. William Alexander, printed in the "Proceedings" of the Institution of Mechanical Engineers in 1917. Having discussed various ideal cycles on which internal combustion engines can be operated, such as the constant pressure, the constant volume, the Diesel, and the dual cycles, Mr. Wells turned to the working fluid. While tables were available giving the properties of steam, ammonia, carbonic acid gas, &c., the internal combustion engineer, he said, still lacked similar data for his working fluid, and in his calculations of ideal efficiency was open to arrive at a seriously wrong result by assuming with the 1903 committee that that fluid was air having constant specific heats. Various experimenters had examined the actual working fluids of internal combustion engines with a view to determining their specific heats, and there was considerable unanimity as to the form of the equations governing their variation with temperature. It was generally agreed that the specific heats at constant pressure C p and at constant volume C v could be expressed by

$$C\,p = a + s\,T + u\,T^2 \text{ and}$$
$$C\,v = b + s\,T + u\,T^2,$$

in which a, b, s and u were constants. These equations represented the apparent rather than the actual specific heats, for at high temperatures there was a dissociation effect which influenced the results of the experiments, but which could not be isolated from the other portion of the heat taken in by the fluids.

Wimperis and Clerk had adopted two-term formulæ, the former giving

$$C\,v = 0.1515 + 0.000075\,T \text{ and}$$
$$C\,p = 0.2225 + 0.000075\,T,$$

and the latter

$$C\,v = 0.18 + 0.000051\,T \text{ and}$$
$$C\,p = 0.251 + 0.000051\,T.$$

Stodola used the three-term form and gave

$$C\,v = 0.167 + 0.000062\,T - 0.725 \times 10^{-8}\,T^2$$
and $$C\,p = 0.2377 + 0.000062\,T - 0.725 \times 10^{-8}\,T^2.$$

In all three instances the specific heats were in Centigrade heat units per pound.

At first sight these equations did not appear to promise much agreement, but it had been shown by Dr. T. B. Morley that for an Otto cycle with a maximum temperature of 1600 deg. Cent. and a compression ratio of 6 they gave almost identical figures for the ideal efficiency, namely, 0.44, 0.435, and 0.45 respectively. Under the same conditions the air standard showed the ideal efficiency to be 0.512.

In addition, in the gas equation P V = R T, R was identical with J × (C p − C v), where J was Joule's equivalent (= 1400 Centigrade heat units per pound). For the three formulæ C p − C v was identical at 0.071, so that R had the value 99.4, or 99 in round numbers. The gas equation could thus be written P V = 99 T, with P in pounds per square foot, V the volume in cubic feet per pound, and T the absolute temperature Centigrade.

Mr. Wells then proceeded to show how by means of this gas equation the internal energy and total heat of the fluid could be calculated at any temperature, and described the construction and use of a nomogram or alignment chart whereby these properties and the temperature of the fluid could be read off if the pressure and volume of the fluid were known.

In opening the discussion, Captain H. R. Sankey, the chairman, submitted five questions which he thought it would be desirable that the meeting should discuss:—(1) Should the standard cycle adopted work between the same temperatures as the actual cycle, as was the case in the steam engine? (2) Was it practically possible to measure the suction temperature? (3) If not, could we take a standard suction temperature for two-stroke and four-stroke engines respectively? (4) What was the best form for the specific heat formula? and (5) Was the nomogram given by Mr. Wells satisfactory for practical use?

Sir Dugald Clerk, while agreeing that the real working fluid and not an ideal fluid should be used as the basis of calculating the ideal efficiency, held that the use of air of constant specific heats gave a method of obtaining an immediate result, for all that was required was a knowledge of the volume of the fluid before and after compression. It was very desirable to determine the nature of the actual working fluid, but he thought that the difficulties in the way of using it as the standard fluid would for some time leave air as the more useful substance. Answering Captain Sankey's questions, he held that, in view of the phenomenon of delayed combustion, it was necessary that the ideal cycle should be taken as covering the same range of temperature as the actual, although it would be necessary to have regard to the type of engine and the nature of the working fluid. It was possible to measure the suction temperature, but the problem was difficult. As regarded the formulæ for the specific heats, he thought that we were not yet in a position to give a standard form. The alignment chart method proposed by Mr. Wells was very good.

Professor W. E. Dalby said that the paper ably stated the problems of the 1903 Institution committee, and brought to their solution a knowledge accumulated by the investigations of the last twenty years. He agreed with the author that all the difficulties revolved round the imperfect knowledge of the specific heats of the working mixture. It would be helpful if the present committee would include in its report the constant temperature type as well as the constant volume and pressure types of ideal cycles. The author had stated that the internal combustion engineer had formulated a very difficult task in the demand for a standard working fluid. He (the speaker) would go further and say that the problem was almost an impossible one, because of the wide range of gaseous and liquid fuels and the conditions obtaining in various types of engines. It was interesting to note that Mr. Wells had brought figures together to show that the characteristic equation obtained from different data had a constant which was so nearly the same. It looked as though this characteristic equation could be used with confidence. He noted that Stodola's constants had been employed and concluded that the Committee had adopted them as being the more reliable. The present Committee was still faced with the difficulty which confronted the 1903 Committee, namely, that the suction temperature had to be assumed. Professor Dalby then gave a brief account of the 1903 Committee tests carried out at the National Gas Engine Company's works at Ashton-under-Lyne on three engines of 5, 20, and 60 horse-power respectively. He outlined the method used for measuring the suction temperature and showed diagrams illustrating the way in which the suction temperature was influenced by the various conditions of working. Reference was also made to the British Association 1908 Committee on the Investigation of Gaseous Explosions and the work done in observing specific heats and temperatures. In conclusion, Professor Dalby gave it as his opinion that the problem of suction temperature still remained open, and the practical difficulties of using a standard other than air were yet to be overcome. Although such a standard could be used—as was shown in the paper—it could not be used without involving assumptions regarding the suction temperature, and more calculation than practical engineers were likely to undertake. This, of course, was no reason why the present Committee should not continues it labours and get together all the information which was available.

Mr. B. Pochobradsky stated that the 1903 Committee, by its references to gramme molecules and volumetric heat, showed considerable foresight, and that these two conceptions, rightly applied, would take us farther than Mr. Wells' paper. In the gas equation P V = R T, if V were made the gramme molecule volume, R was constant for all gases, and the nomogram chart, if compiled on a gramme molecule basis, would also apply to all gases. The volumetric heat was equal to the specific heat per gramme molecule, and was the same for all gases. Similarly, the entropy was the same. On this basis the specific heat at constant pressure for all diatomic gases had the form $a + b\,T$ with a similar form, but different constants for the specific heat at constant volume. For multi-atomic gases the specific heat took the form $A + B\,T + C\,T^2$. In internal combustion engines diatomic gases predominated. He therefore urged that the use of pounds, &c., should be given up and that all calculations and diagrams should be transformed on to the gramme molecule basis.

Mr. W. G. Shilling referred to a monograph which would shortly be published and which would give for the first time a complete and critical survey of the work done on specific heats from 1788 up to the present year. Assuming corrected values in the characteristic gas equation, he had found the value of R in Centigrade heat units to be 96. In the formula $a + b\,T + c\,T^2$ he did not think that the T^2 term could be omitted if accurate results were required. There was no doubt that if the molecular unit were adopted and a common system of units used it would be much easier for the chemist, physicist and engineer to work together on the solution of internal combustion engine problems.

Mr. R. H. Parsons criticised the assertion made by Mr. Wells that there was unanimity as to the form of the formulæ for the specific heats of the working fluid. The fact that two of the formulæ had two terms and the third three did not look like unanimity. Even though the three-term formula were generally favoured, it would not imply unanimity, for such a form was always adopted to express experimental results of all kinds when there was doubt as to the true form. It was an accommodating type of formula, but it was not safe to extrapolate from it. In Stodola's case the third term had a negative coefficient, and that fact seemed to him to be irrational, as it implied that the specific heats became zero at some high temperature—round about 5000 deg. Cent.

Mr. Wells, replying to the discussion, said that he had not expressly favoured Stodola's three-term formulæ for the specific heats, but had chosen them as a basis for his work because, being more complex than the two-term forms, they revealed better the simplicity with which the nomogram could take account of any type of formula. He reminded the meeting that the paper was in no way an expression of the views of the Committee, but was an attempt to elicit further information for the Committee to work upon.

Captain Sankey suggested that the meeting be termed a preliminary discussion, and that after the contributions of that evening had been considered by the Committee a further meeting should be called to consider a new draft report.

ENGINEERING IN SOUTH AFRICA.

(By a South African Contributor.)

THE engineering industry in South Africa is one of the most important in the country. The large requirements of the Rand Gold Mines have led to the erection at Johannesburg of a number of engineering shops and foundries, while at Cape Town the need for making provision for carrying out repair work to vessels entering the port, no matter what the magnitude of the job, has brought into being engineering works of considerable size, which are equipped with the most up-to-date plant and machinery for dealing with marine or land work. The great complaint made by the heads of these concerns is that the extensive and costly equipment, which has had to be installed, because of the heavy and intricate operations which have to be undertaken—should be mainly employed on repair work, while there is so much of a constructional character imported into the country. That the complaint is well founded was brought home to me on a recent visit to the engineering centre of Johannesburg. There is practically nothing that this country needs which the local engineering resources would not be capable of making, provided that raw material could be obtained at reasonable prices; but so long as the raw materials have to be imported South African manufacturers cannot hope to compete with the imported finished goods. Pig iron has, of course, to be got from abroad, and, in addition to the heavy freight and rail charges it has to meet, there is the anomaly that a protective tariff, which was put on when the Pretoria iron mines were working, has not been taken off, in spite of the fact that supplies are no longer obtainable from local mines. The rail charges are also a serious handicap. A consignment of pig iron recently bought in England and landed at Durban for £162, cost no less than £122 to convey from Durban to Johannesburg, though the consignment consisted of only one truck load.

For these reasons the engineering companies are hoping for the speedy putting into operation of the Newcastle blast-furnace. They assert that they could treble their output if they could get the necessary raw material, and they would be able to provide the market for locally made pig iron.

In all probability, however, in less than another twelve months these firms will be able to obtain locally made pig iron. The Government has recently decided to award a bounty, per ton of pig iron produced, of 15s., and per ton of steel produced from such pig iron another 15s., but the bounty will only be paid if the plant is capable of producing 50,000 tons of pig iron or steel per annum. The bounty of 15s. per ton will be paid for three years, that is, up to the financial year 1926–27; then 12s. 6d. will be paid for one year, 10s. the next, 7s. 6d. the next, and so down to the year 1931–32, for which the bounty will be 2s. 6d. per ton.

The Newcastle blast-furnace, which is now approaching the producing stage, will be capable of turning out 50,000 tons of pig iron per year, while the Union Steel Corporations works at Vereeniging will be able to manufacture about 75,000 tons of steel. These two undertakings are now amalgamated.

IRON AND STEEL INSTITUTE.

As already announced, the annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George-street, Westminster, on Thursday and Friday, the 8th and 9th of May, 1924, commencing each day at 10.30 a.m.

The following programme of proceedings has been arranged:—On Thursday, May 8th, at 10.30 a.m., there will be a general meeting of members, at which, after the usual business, the newly-elected president, Sir William Ellis, G.B.E., will be inducted into the chair, and present the Bessemer Medal to Professor Albert Sauveur. Sir William will then deliver his presidential address, following which a selection of papers will be read and discussed. At the afternoon session further papers will be taken. At 7.15 p.m., annual dinner of the Institute in the Grand Hall of the Hotel Cecil, Strand, W.C. On the Friday, May 9th, the award of the Andrew Carnegie Research Scholarships for 1923 will be announced, and a selection of papers will be read and discussed at both morning and afternoon sessions.

The following is a list of the papers which it is expected will be submitted at the meeting:—(1) L. Aitchison and W. L. Johnson, "Notes on the Testing of Metal Strip"; (2) J. H. Andrew and H. Hyman, "High Temperature Growth of Special Cast Irons"; (3) J. P. Bedson, "Continuous Rolling Mills, their Growth and Development"; (4) G. S. Bell and C. H. Adamson, "Transverse Test Bars and Engineering Formulæ"; (5) E. W. Colbeck and D. Hanson, "The Hardening of Silico-manganese Steels"; (6) W. Dyrssen, "Recovery of Waste Heat in Open-hearth Practice"; (7) C. A. Edwards and L. B. Pfeil, "The Production of Large Crystals by Annealing Strained Iron"; (8) W. N. Hindley, "Some Effects of the Penetration of Arsenic and Sulphur into Steel"; (9) K. Honda, "On the Forging Temperature of Steels"; (10) K. Honda and K. Takahasi, "On the Indentation Hardness of Metals"; (11) D. J. Macnaughtan, "Hardness of Electro-deposited Iron, Nickel, Cobalt and Copper"; (12) A. L. Norbury and T. Samuel, "Experiments on the Brinell-tensile Relationship"; (13) H. O'Neill, "The Effect of Cold-work upon the Density of a Iron"; (14) J. Seigle, "Theoretical Considerations Respecting Certain Features in the Working and Efficiency of Reversing Regenerators"; (15) F. C. Thompson and W. E. W. Millington, "The Plastic Deformation of a and γ Iron"; (16) A. Westgren and G. Phragmén, "X-Ray Studies on the Crystal Structure of Steel," Part II.

IT is computed that only 15 per cent. of the houses in the United Kingdom are using electricity in any form. In Glasgow there are over 200,000 unwired houses and only 14,500 domestic electric light consumers.

TRADE CONDITIONS IN ITALY.

WHILE little unemployment prevails in Italy, difficulty is presenting itself in the form of insufficient orders to keep some of the larger industrial establishments remuneratively busy. The home demand has slackened considerably in the iron, steel and machinery trades. Without as yet displaying depression, there are considerable numbers of plants which are far from experiencing a normal amount of prosperity. It is thus necessary for Italian manufacturers to look further afield for orders, but keen competition is being met with abroad, particularly from both German and American firms.

The national industry which enjoys the greatest prosperity at present is that of motor vehicle construction. Several factories, which had previously been compelled to shut down or reduce their output, have now reverted to normal production, the domestic market, in view of the summer months' demands, proving more active. Export orders are also increasing, and it is expected that the industry will very soon be in normal activity. According to the latest statistics available, the number of self-propelled vehicles at present employed in Italy is as follows:—Passenger cars, 45,000; lorries and commercial vehicles, 30,000; and motor cycles, 50,000.

The cotton trade is in a sounder position than it was, the depression noticed in the spring months, when part-time only was general in the textile mills, having passed. Both local and foreign markets show symptoms of strengthening, being aided by the fact that stocks have been reduced practically to a minimum. Similar conditions prevail in the wool industry, but a reaction in the raw silk trade has taken place since the unexpectedly favourable opportunities created by the Japanese earthquake disaster were satisfied. The labour situation generally is considered excellent, both with regard to the efficiency displayed and regularity of attendance. While in 1920 the number of strikes caused a loss of over 30 million and in 1922 nearly 7 million working days, the record for 1923 did not exceed 245,000 working days. The cost of living remains approximately at the same level as it was twelve months ago, while wages have undergone no alteration.

SIXTY YEARS AGO.

THE use of petroleum as fuel was beginning to attract attention sixty years ago. In our issue of April 8th, 1864, it was stated in the course of an article on the subject that the price of petroleum at that date was £20 per ton, which, in view of its enhanced heating power, made it equivalent to coal at about £10 a ton. Its cost, it was admitted, was against it, but it was anticipated that in years to come it would fall in price, and would rival or supplant coal, particularly in war vessels. The Americans, we read, had appointed a commission to inquire into the use of petroleum as fuel, and that body had reported that not only was it twice as powerful as anthracite coal in the production of steam, but that steam could be raised by it in half the time. Two difficulties were mentioned as standing in the way of its use. First, it was not understood how the fuel was to be applied to the boilers, whether by small burners or otherwise; secondly, petroleum was a substance "so alarmingly liable to almost spontaneous combustion as to be even more dangerous than gunpowder itself." The Metropolitan Board of Works, it was added, regulated its storage in London, and without a licence not more than 40 gallons could be kept within 50 yards of an inhabited house. . . . The beginning was recorded elsewhere in the same issue of a long-expected contest at Shoeburyness between the Whitworth and the Armstrong systems of artillery. The trials were carried out before the members of the Select Ordnance Committee. For the contest Sir William Armstrong had entered three 12-pounder breach-loaders and three muzzle-loading shunt guns of the same calibre. The Whitworth guns were three 12-pounder muzzle-loaders. It was intended that the guns should be tested in a very thorough manner, and it was anticipated that the trials would extend over two or three months, during which time at least 3000 rounds would be fired from each gun. . . . In a short paragraph it was stated that the steamship Great Eastern had been taken over by Glass, Elliott and Co. for the purpose of laying the new Atlantic cable. The cost of that cable, it was remarked, would be £700,000, and the operation of laying it would be begun in the following spring. The expenses of the Great Eastern, including wages, victualling and insurance, were to be paid by Messrs. Glass, Elliott, and when the cable had been laid the firm would be required to pay the proprietors of the Great Eastern £50,000 in paid-up shares in the Atlantic Telegraph Company.

BOOKS OF REFERENCE.

Hydro-electric Power Stations. By David B. Rushmore and Eric A. Lof. London: Chapman and Hall, Limited. Price 37s. 6d.—The second edition of this book deals with the most up-to-date hydro-electric power station practice. Students and engineers who are interested in the subject will find the volume useful, although a good deal of the electrical portion covers ground which other books cover. Much of the electrical information applies equally well to steam stations and supply systems which do not depend on water power. Still, the volume deals at considerable length with water power, and the fact that a second edition has been published indicates that it is a book of merit.

Ryland's Directory, 1924. Embracing the Coal, Iron, Steel, Tin-plate, Engineering and Allied Trades. London: The *Iron and Coal Trades Review*, Bessemer House Adelphi, Strand, W.C. 2. Price £2 2s. net.—The seventeenth edition of this work has just been received. The volume runs to over 2000 pages, and is divided into separate sections, which are plainly marked. The alphabetical section contains, not only the names of firms and trades represented, but also the subscribed capital, names of directors, partners, &c., and the various classes of manufactures. A list of firms classified according to counties and towns is also included. Much attention has been devoted to trade classification. The iron and steel section deals with pig iron works, Bessemer and open-hearth steel works, electric steel works, finished iron works, rolling mills and tin-plate makers. Merchant exporters have been apportioned a section, and lists of foreign pig iron, steel and puddled iron makers, together with rolling mills of the world, and foreign collieries are given places. The tables of rolled sections will be found valuable for reference.

Sell's Directory of Registered Telegraphic Addresses, 1924. London: Business Directories, Limited, 8–9, Johnson's-court, Fleet-street, E.C. 4.—We have before us the thirty-ninth edition of this valuable directory. Every new issue we receive is bigger than the last, and this issue contains the names of over 100,000 firms which reside in the United Kingdom. Their postal addresses, telephone numbers, trades or occupations, together with registered code word, are all included. These code words are alphabetically arranged in a separate section, which simplifies identification when a telegram is received. A trade section is included in each volume, and as many as 130,000 firms have been classified under 3500 trade headings. This new issue contains an enlarged newspaper section, which gives particulars of the most important papers published in the United Kingdom. All the information has been corrected up to the very latest possible time. The directory is published at 45s. net.

The Electrician Electrical Trades' Directory and Handbook, 1924. London: Benn Brothers, Limited, 8, Bouverie-street, E.C. 4.—We have received the forty-second edition of "The Blue Book." Careful revision has been going on during the year, and particulars in the present volume have been brought up to last January. Both the alphabetical and classified sections have been increased in size, and, where necessary, whole sections have been re-written to keep the book quite up to date. Several new subjects are included. Amongst them may be mentioned the revised Cinematograph Regulations of the Home Office, particulars of the British Broadcasting Company's service, the Broadcast Receiver and Licence Conditions, certain new regulations of the Electricity Commissioners, the terms of the reorganisation of electricity supply and of the constitution of joint electricity boards. The year's progress in telegraphy and telephony is also recorded. The volume is published at 25s. net.

POPULAR LECTURES.—The following Popular Lectures have been arranged by the Architects' and Surveyors' Assistants' Professional Union, Metropolitan Branch. The meetings will be held at the Building Exhibition, Olympia, and admission will be free:—Saturday, April 12th, at 6.30 p.m., "The Houses We Live in;" speaker, Raymond Unwin, F.R.I.B.A., Chief Architect to the Ministry of Health; Monday, April 14th, at 6.30 p.m., "Plays and Playhouses;" speaker, Miss Lena Ashwell; Wednesday, April 23rd, at 6.30 p.m., "Motor Users and the Roads;" speakers, Lord Montagu of Beaulieu and H. V. Lanchester, F.R.I.B.A.; and Friday, April 25th, at 6.30 p.m., "The Modern School and the Future Race;" speaker, G. Topham Forrest, F.R.I.B.A., Chief Architect, L.C.C. Tickets of admission to the Exhibition may be obtained from the general secretary, A.S.A.P.U., 36, Victoria-street, S.W. 1.

A COMPLIMENTARY DINNER.—On Thursday last Sir Trevor Dawson presided at a complimentary dinner held at the Hotel Cecil, which was given by Vickers and International Combustion Company, Limited, in honour of three American power station engineers, Mr. C. W. E. Clarke, Mr. F. H. Rosencrants, and Col. E. McCullough, who are here on a visit to Great Britain. After dinner the visitors spoke on the more recent power station developments in the United States, and particularly on the advances which have been made in large power station design by Dwight P. Robinson, consulting engineer, New York. Air pre-heating plants, stage bleeding for feed heating, and the Lopulco system of pulverised fuel were described and illustrated. Mr. Geo. Usher, of Barrow, proposed the toast of "The Visitors," which was replied to by Mr. Frank Hodges and Mr. J. Horace Bowden. Mr. Hodges expressed his interest in a system which would utilise small and friable coal and reduce the present waste in coal mining.

THE INSTITUTION OF MINING AND METALLURGY.—The annual dinner of the Institution of Mining and Metallurgy was held at the Hotel Victoria on Thursday, April 3rd. It was very well attended. Mr. R. G. Gilman Brown, the president, occupied the chair. After the Royal toasts, Sir Thomas Holland was the first speaker. He dwelt particularly on the relatively little attention we were giving to our supplies of base metals—lead, copper, and zinc. The British Empire did not produce enough of those three metals to satisfy the needs of Great Britain alone. The president, in acknowledging the toast of the Institution, gave some particulars as to the Empire Congress on Mining and Metallurgy, which is to be held in London in June. Sir Joseph Cook, High Commissioner for Australia, also spoke. He desired to see the Australian education and training of mining engineers regarded as equivalent to those of the Mother Country. He congratulated the Institution on the services it had rendered in the development of the Empire.

SALE OF A FAMOUS WATER PIPE LINE.—When, during the Great War, British troops began to march on Palestine from Egypt, one of the great problems to be faced was that of water supply. In the barren wilderness of Sinai but few wells are met with, and they, though they sufficed to meet the needs of the comparatively small caravan parties of the past, were totally inadequate to furnish the supplies necessary for a great modern army. As our readers are already aware, the difficulty was surmounted by pumping water from the Nile for nearly 200 miles across the desert—one of the great engineering feats of the war. The pipe line ran from El Kantara on the Suez Canal and followed one of the oldest caravan routes in the world, namely, that by which through untold ages those proceeding from Palestine to Egypt or *vice versâ* have travelled. The water was drawn from the Sweet Water Canal in Egypt by the Kantara waterworks, was treated with alum and then filtered. Thereafter it was pumped by syphon underneath the Suez Canal and delivered into reservoirs on the eastern bank. There it was chlorinated and then pumped by successive stages through the pipe line across the desert into Palestine. The pipes have apparently been well preserved in the dry sand, and some 130 miles or so of tubes, weighing about 7000 tons, are being taken up and stacked at Kantara ready for sale and shipment. The pipes, which are lap welded, screwed and socketed, vary in size from 6in. diameter, $\frac{1}{4}$in. to $\frac{9}{16}$in. in thickness, to 12in. diameter and $\frac{5}{16}$in. to $\frac{1}{2}$in. thickness, and are in 15ft. to 21ft. lengths. They are being offered for sale by Thos. W. Ward, Limited, of Sheffield, and 18, Billiter-street, London, E.C. 3.

A Self-propelled 350-Ton Floating Crane.

AMONG the large floating cranes which have been constructed during recent years, a noteworthy example was that which was built for the United States Navy Department, and was described in THE ENGINEER of June 29th, 1923. That crane, it will be remembered, was built on to the hull of an old battleship the Kearsarge, and it was designed to lift 250 tons at a radius of 101ft. The hull of the battleship was before its conversion 72ft. 2½in. in width, with a total displacement of 11,525 tons. Bulges were added and the width increased to 92ft., the removal of superstructure and machinery then reducing the displacement to 10,350 tons. At the time the description appeared, the impression was given by the American and some British journals that it was the largest floating crane in the world. Floating cranes of greater capacity have, however, been constructed by Cowans, Sheldon and Co., Limited, of Carlisle, and one of a considerably larger type was recently sent out to Japan. It was designed to lift a working load of 350 tons at 100ft. radius, or 300 tons at 121ft. radius. It is of interest to compare the characteristics of this crane with those of a previous crane supplied to the British Admiralty in 1915 by the same builders, and with those of the American Kearsarge crane. In making this comparison, it is assumed that the working load of the American crane is given in the American short tons of 2000 lb. The following are the leading particulars of the three cranes:—

Crane type.	Net load in British tons.	Radius in feet.	Lifting moment, foot-tons.
250-ton Kearsarge	223.2	101	22,543
250-ton Cowans, Sheldon	250	100	25,000
350-ton Cowans, Sheldon	350	100	35,000
	300	121	36,300

These figures show that the American crane has a less capacity than had the British crane, which was designed and supplied a number of years before it, and that the 350-ton crane, which forms the subject of the present article, is over 37 per cent. larger as regards its lifting moment. Again, whilst the American crane was built on a battleship hull, which was, of course, very helpful from the point of view of stability, the British crane was—in view of its being designed to meet world-wide competition—placed on as small a pontoon as possible. The accompanying drawing and the illustrations reproduced in our Supplement give some idea of the size of the pontoon in relation to the superstructure. It may be noted that the pontoon is 270ft. long and 91ft. wide, with a draught of 10ft. The comparatively small size of the pontoon confers a greater useful crane radius beyond the ship's side, and it will be seen from the illustration of the completed crane that a load can be lifted over the end of the pontoon as well as at the sides. This feature is very useful when working in narrow and congested waterways, particularly when such operations as the raising of lock gates, &c., have to be undertaken.

The crane and its machinery was built to the order of Mitsubishi Shoji Kaisha. It was partially erected in the makers' works at Carlisle, and was afterwards re-erected in Japan under supervision of one of the builders' engineers. The pontoon and the propelling machinery were constructed by Mitsubishi Shoji Kaisha, Limited, to drawings prepared for Cowans, Sheldon, Limited, by Sir W. G. Armstrong, Whitworth and Co., Limited. Before giving an account of the interesting work of erecting such a large structure on a floating base, some particulars of the design of the crane and its operating mechanism may be given.

GENERAL PARTICULARS.

The crane is constructed to lift and revolve through a complete circle with loads up to 350 tons at 100ft. radius or 300 tons at 121ft. radius, and is capable of lifting either of those loads through a vertical distance of 140ft. The main loads are lifted on two independent blocks of 175 tons capacity each, and the operating machinery is so arranged that these blocks may be used either independently or coupled together, as desired. An auxiliary purchase of 50 tons capacity is provided at the end of the jib, at a distance of about 40ft. in front of the main purchase, and this block is arranged for a vertical lift of 200ft. There is also an additional purchase of 50 tons capacity carried on a trolley arranged to travel along the underside of the jib to a sufficient extent to move the load through a distance of about 75ft., measured horizontally. This feature enables the crane to deal with comparatively small loads at a quick speed without the necessity of using the derricking motion.

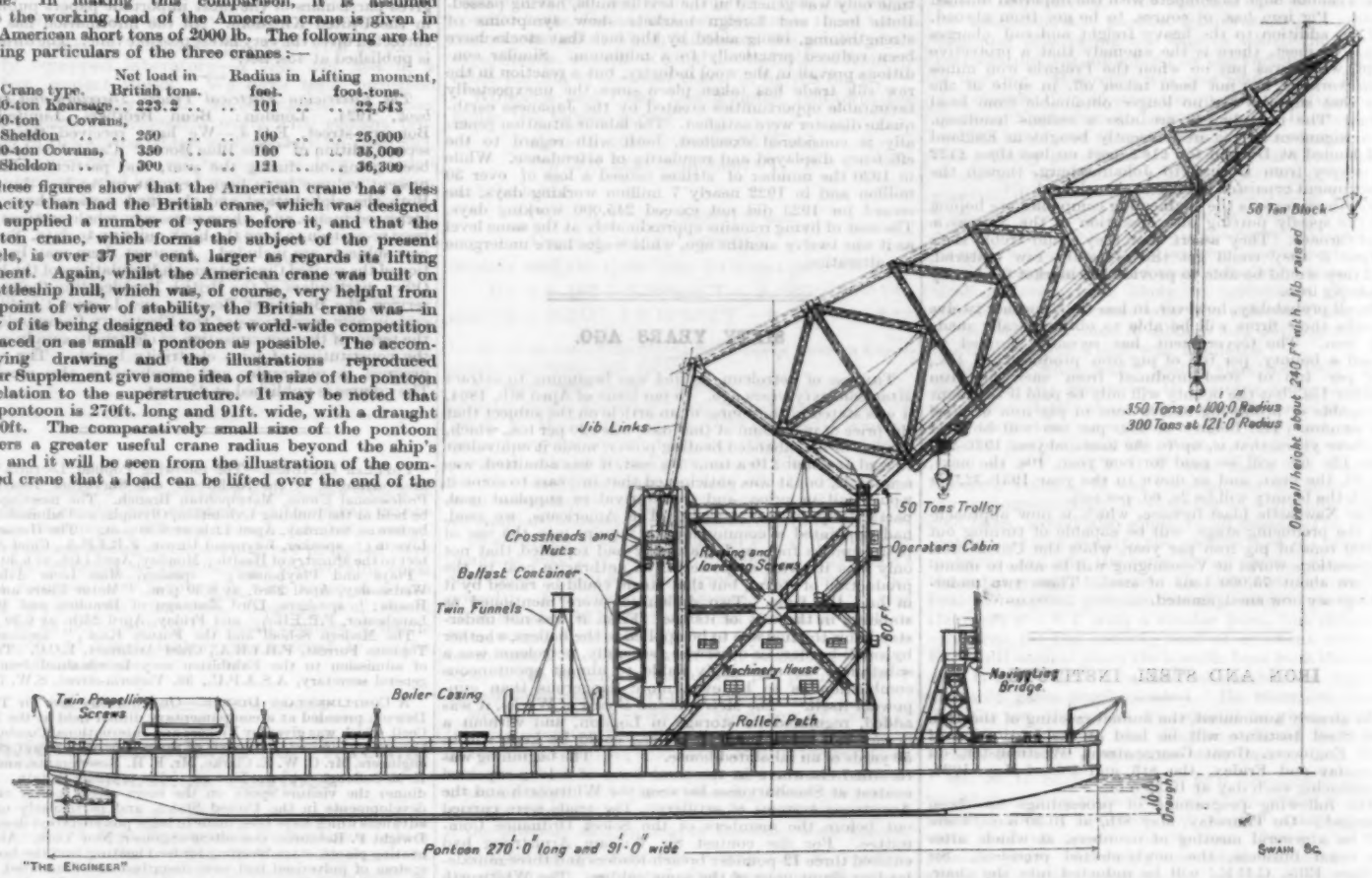
The jib is designed to be capable of derricking in from the maximum radius of 121ft. to a minimum radius of 50ft., and when in this condition—as illustrated above—the overall height to the top of the crane is approximately 240ft. It will be seen that the entire crane is mounted on a roller path, which has a diameter of about 50ft., and is furnished with specially arranged machinery, enabling the crane to be revolved with its load through a complete circle in either direction. Each individual motion is operated by an independent set of double cylinder engines fitted with link motion reversing gear, and there are altogether nine such sets of engines on the crane.

The raising and lowering of the jib is effected by means of two large steel screws, 49ft. long and 14in. in diameter, situated at the back of the crane, which are driven from the engines through a train of gearing and arranged to engage with nuts housed in the crosshead. The crosshead is 34ft. wide, and to it the links from the jib are attached. The load on the screws for this crane was exceptionally heavy, and very careful consideration was given by the makers to the provision of adequate bearing surfaces and an efficient system of lubrication. It is interesting to learn that this motion worked with complete satisfaction throughout the extensive trials to which the crane was subjected on its completion.

Superstructure.—The superstructure consists principally of a rectangular braced frame, which supports the jib and also carries the guides for the crosshead. It is about 66ft. high, measured from the roller path to the jib foot pivot, and the whole of this structure had to be designed with special care in order to withstand the various forces which it had to carry, and which are of a magnitude not reached in any previous floating crane. Whilst the framing be designed so as to ensure adequate stiffness and freedom from deflection. That this result was attained by the makers, was shown by careful observations made under the test load, which showed that no measurable movement took place in the structure, beyond the normal calculated deflections allowed for in the design. The ballast which is necessary to give the requisite stability to the crane and pontoon is contained in a large steel receptacle formed at the extreme back end of the crane and attached to the superstructure. It may be noted also that the pontoon was made of such a size that any moving or water ballast which would have to be adjusted at the discretion of the operator was rendered entirely unnecessary.

Brakes and Controls.—The two main lifting gears and both the auxiliary lifting gears are each provided with specially designed hydraulic brakes to sustain and control the lowering of the loads, and these brakes are strong enough to enable a desired load to be sustained with safety or lowered with precision at any speed between the maximum speed and the lowest possible creeping speed which may be used in practical working. The whole of the motions are controlled by one operator, whose cabin is situated immediately beneath the jib foot, from which a clear view of the load and the site over which the crane is working is obtained. The various motions are operated by a special system of control gear which has been successfully developed by the makers, and which they state enables steam cranes of the type we are describing to be worked with the same ease and precision as that obtained when electric power is used. The steam for operating the different engines is taken from the ship's boilers through a rotary connection at the crane centre, and the exhaust is in each case returned in a similar manner to an independent condenser, which is arranged to work in conjunction with either the crane or propelling machinery.

The Pontoon and Deck Auxiliaries.—The pontoon, illustrated below, is 270ft. long by 92ft. wide, and it has a draught of approximately 10ft. A large area of the deck behind the crane is provided with seating timbers, and otherwise arranged so that it is possible to carry a deck load of about 700 tons. All the propelling machinery is placed amidships, and it consists of twin screw compound engines, which are supplied with steam from two single-ended boilers at a pressure of 150 lb. per square inch. The hull of the vessel was constructed entirely of steel, and it is divided into a series of water-tight compartments by means of transverse and longitudinal bulkheads. The understructure supporting the crane was specially designed to carry the enormous revolving load with practically no deflection, a feature which is essential in order to ensure accurate bearing on the roller path in all positions. In connection with this, it may be remarked that the entire roller pathway was accurately machined by a special machine tool which the makers have constructed for this purpose, and which has given highly satisfactory results on this and other large cranes which the firm has made. The deck equipment comprises a steam windlass with warping ends, four steam capstans, and complete steam and hand steering gear, together with the usual complement of skylights, scuttles, bollards, fairleads, davits, lifeboats, and all other auxiliaries necessary for a sea-going vessel. As will be seen from the accompanying drawing, the navigation of the ship is controlled from a steel bridge extending the full width of the deck, which is situated immediately in front of the crane base. Double timber fenders, fitted with vertical rubbing pieces and placed at the sides and ends, protect the hull in the usual way.



ARRANGEMENT OF COWANS, SHELDON 350-TON FLOATING CRANE

ERECTION AND TESTING.

In to-day's Supplement we reproduce a series of photographs depicting this large crane in the various stages of its erection. As may be well imagined, the enormous size of the structure and the weight of various finished parts was such as to demand a very carefully planned scheme of erection. The difficulties and dangers were enhanced by the fact that assembly had to take place on a floating base, which from time to time had to be careened to a sufficient angle to enable parts to be joined together. We have already mentioned that the main parts of the crane were assembled at Carlisle, and were shipped in pieces of appropriate size for erection. The work on site was facilitated by the service of another floating crane, which had previously been supplied by the same makers.

Our Supplement illustrations show six typical stages in the work of erecting the jib, which weighed over 300 tons. The first operation was to lift the lower section from the quayside and place it in position for securing to the superstructure. This operation, which is illustrated by the first four views, was completed in the short space of six hours. Then followed the lifting of the top section, which proved a delicate and difficult task, especially in the final stages just before it was attached to the lower section. This work occupied only four hours, which bears testimony to the extreme accuracy with which the various component parts were manufactured and prepared for placing together. After its completion, the crane was subjected to an extensive series of trials, and we are informed by the builders that everything was shown to be in full accordance with the specified requirements, and that the trials were carried out to the entire satisfaction of all concerned.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

A Quiet Market.

Although the tone of the market remains good, last week's quarterly meeting has not added very materially to producers' order books, and the situation remains much the same as before it was held. Business is still limited for the most part to the requirements of the immediate future. In the uncertain outlook, neither buyers nor sellers care to commit themselves far ahead. Contracts have been made for pig iron over the third quarter, but only in isolated cases. The coal situation is a very serious obstacle, and it is generally assumed that any settlement arrived at will further increase fuel costs. The relaxation in foreign competition has improved the lot of iron and steel producers somewhat, but demand is still small. The consumption of certain classes of material has increased with the evolution of development schemes, and the re-animation of particular branches of engineering, but there has been no perceptible quickening of the general body of trade, so far as the heavy industries of South Staffordshire are concerned. The prospects of the new quarter depend to some extent upon the outcome of the labour ferment, for under the intimidation of strikes and lock-outs, the market must remain more or less depressed. The projected movement for a general advance in the wages of all classes of engineering workers in the Black Country is a matter of first importance to this district. It is the opinion of manufacturers that the industry cannot stand a wages advance at present. Enough work cannot be obtained to keep the shops going on the basis of the present costs, apart from the motor industry, and, although most of the works are busy, they are busy at unremunerative prices in many instances.

Bar Iron Prices.

The advance of 10s. per ton in Staffordshire marked bars, bringing the price to £15, has had little perceptible effect upon demand, which has been fairly stable for some months past. The makers of best iron have been busy since the year opened, and have still good reserves of orders. The impelling reason for the increase in price—which has been £14 10s. for twelve months—is said to be the increased cost of production. Ironmasters consider the advance will not cover the extra cost of wages, fuel and other materials. It is probably on the strength of the increase in the standard for marked iron that some of the makers of Crown bars have stiffened their prices. In very special cases as much as £13 has been paid by consumers, who made £12 10s. their maximum last week. The basis, however, remains at £12 10s., and some merchants claim to be able to buy good iron at £12 7s. 6d. Nut and bolt bars remain at £11 12s. 6d. up to £11 15s., so far as the regular run of business goes. Here, as in other directions, continental competition has been modified by the recovery of the franc. Latterly, millowners have ignored quotations from the Continent. The disparity—£3 or more—was too great for the home producer to have any chance of getting on competitive terms. He has accordingly elected to trade only on an economic basis, whatever curtailment of business it involves. Iron strip is in fairly strong demand and an upward trend of prices during the past week or two has taken quotations well above £13 5s., more being asked in some instances.

Galvanised Sheet Values.

Manufacturers of galvanised sheets who have been badly needing orders to keep their mills in full employment, have recently made heavy price cuts. Prices generally have this week further receded to about £17 15s. for 24 gauge corrugateds. There is still a good overseas demand for thin gauges, but the general volume of the trade has contracted.

Wrought Iron Prices and Production.

A matter which has during the week received considerable attention and has formed the subject of much discussion in Midland engineering circles is the difference in price between wrought iron and steel, as compared with that ruling in pre-war time. This is stated to be a considerable factor in the lag of wrought iron production in this district, as compared with that of steel. The matter was brought to the front by Mr. Macpherson at the annual meeting of the Midland Iron and Steel Wages Board, when he urged the need of further inquiry into the question of costs of wrought iron with a view to the cheapening of production. The value of wrought iron to the country was, he thought, not sufficiently realised, and it would be a national calamity if both sides did not exercise every ingenuity, use every facility provided by science, and approach the question with the utmost determination to restore something like the former relation that existed in price between iron and steel.

Steel Prices Less Irregular.

A fair amount of business is being placed for steel, but the threat of labour disputes destroys confidence and prevents forward bookings. The principal steel works have still orders to work off, and some good lines have been placed lately, especially for plates. More constructional work is being given out, including contracts for bridges, calling for rather heavy tonnages of steel, and constructional engineers are getting busier. It is believed that if labour troubles were out of the way, some expansion might be looked for. Makers cannot possibly forecast future coal prices, though the belief is general that the coal settlement will raise the price of fuel of all kinds. A general complaint is that works coal costs at least 4s. per ton more than in the opening months of the year. Steel values are less irregular. The minimum quotations of a fortnight ago are not now acceptable as a basis of negotiation. The £9 15s. quotation for angles and joists applies only to big contracts. There is no disposition to yield to the pressure of the small buyer. Plates are unaltered. There is no longer any considerable cutting of the accepted values. Small steel bars can still be bought down to £9 15s. This figure is based upon the low-priced continental billets that have been coming in, but which are no longer to be got at the rates which prevailed a few months ago. For good grade bars, £10 is usually asked. The re-rollers have still good orders on hand, and have largely taken advantage of cheap steel from the Continent. But recently one of the largest of the English railways has inserted a proviso in its invitations to tender that only English material must be used. In one case at least foreign raw and semi-finished steel has turned out unsatisfactory. This railway has been ordering to the value of several millions, and the new policy, especially if it is followed by other lines, will have a great effect upon the steel trade. Native billet prices are steadier. The £8 quotation has become more rare, £8 5s. being commonly required, whilst some makers are not prepared to do business at less than £8 10s. Very little semi-finished steel is on offer from Belgium, though heavy tonnages have still to be delivered. The Belgian price is now up to about £7 5s., but it is intimated that new business will not be accepted for delivery under two months. The steel works are becoming keener for new business, the large orders taken in the autumn now approaching exhaustion. But a few useful lines have been taken lately.

Steel Scrap.

Steel scrap prices are slightly higher, many sellers asking up to £4 15s. per ton. Consumers appear to be more inclined to buy, their stocks having been nearly exhausted.

Tinned Sheets.

The Tinned Sheet Manufacturers' Association has re-declared prices as follows:—Best charcoal, £60; charcoal, £58; unassorted grades, £54 per ton to 20 gauge; Lead-coated sheets remain at £28 per ton to 20 gauge.

Pig Iron.

There is no new development in the pig iron market. Orders rule small, 50 to 500 tons, though prices are inclined to advance. Some producers in Northamptonshire and Derbyshire this week ask 1s. per ton above the recognised figures, both for forge and foundry sorts. This coincides with some recovery in the Middlesbrough market, though the position is not considered healthy, with large stocks in Cleveland, two furnaces extinguished in Barrow and another reported to be likely to cease production in the Dudley area. There appear to be symptoms of an easing of the tension in regard to coke, but the anxiety as to the coal supply keeps quotations up to about 26s. 6d. per ton at ovens. The all-important question of a readjustment of wages in the coalfields still remains unsettled, and whatever comes of it there is little prospect of relief for the iron trade. Another strike would be disastrous. Some of the blast-furnaces which were put out of action by the hold-up three years ago have been idle ever since. If a strike is averted by meeting the demands for higher wages, the increase will go on to the selling prices of fuel, and all the evidence goes to show that prices are already so high that they are retarding consumption.

Coke Situation.

The fuel situation remains a matter of much concern, and Midland industrialists point out that the effect of the recent re-declaration of a contract price for coke of 24s. per ton at ovens for Midland blast-furnaces is liable to misconception. Actually, this represents only a qualified stabilisation. It does not mean that a larger output of pig iron can be developed on the basis of coke at 24s. per ton. The contracts are limited to the tonnages specified in previous commitments. Anything outside these must be paid for according to the exigencies of the market. Probably not more than three-fourths of the current output of pig iron is covered by these contracts. The deficiency has to be made up at prices ruling on the open market, which have been anything from 2s. to 5s. above the contract price.

Midland Iron and Steel Improvement.

Considerable improvement in the iron and steel trade of the Midlands during 1923 was reported at the annual meeting of the Midland Iron and Steel Wages Board. Mr. George Macpherson, presiding, said last year he referred to certain figures of sales of the nineteen selected firms which indicated a gradual improvement. The figures for the last six months of the year represented an increase of 66,714 tons over the same period last year, with an increase in price of £1 8s. 7d. per ton, and an advance in wages of 15 per cent. The increase in the sales was still at a greater percentage than that of the other iron-making districts, their Board showing 68 per cent. advance, the Scottish Board 45 per cent., and the North of England Board 37 per cent. advance. He pointed out that in both pig iron and steel the advances in the manufacture were much more marked than in finished iron.

Miners' Wages Prospects.

From returns rendered by the collieries to the Mining Association, it appears that the results of colliery working in January and February—the period governing wages payable in May and June—will show figures which will be very advantageous to the men in the Eastern Federated Area. This area includes Yorkshire, Notts., Derbyshire, Leicestershire, Cannock Chase, and Warwickshire, and the miners in those districts will receive an addition to their present wage rates of not less than 15 per cent. on the basis under the terms of the present agreement, or not less than 20 per cent. under the terms of the owners' recent offer. Expressed as earnings, this increase would represent an average addition of not less than 6s. per week under the present terms, or not less than 8s. per week if the ballot goes in favour of acceptance of the owners' offer.

Workless.

The number of workless in the Midland area is now down to 121,666, having fallen during the week by a further 3079. In industrial circles hereabouts, it is considered a fairly satisfactory state of affairs. The number of unemployed in the Birmingham area is now 30,623; Bilston, 2553; Coventry, 1661; Cradley Heath, 4015; Dudley, 3749; Oldbury, 1627; Smethwick, 4236; Stourbridge and Brierley Hill, 3317; Walsall, 5389; West Bromwich, 2656; and Wolverhampton, 6436.

LANCASHIRE.

(From our own Correspondents.)

Manchester.

General Outlook.

There has been a slightly better feeling this week in the iron market here, although this has not yet extended to steel or to metals generally. One of the causes of this feeling in Manchester is no doubt the cheerfulness at the Birmingham quarterly meeting, which was held in advance last week. That meeting is described by those who attended it as much more satisfactory than has been the case for quite a long time; and it is thought here that if we can get through the next three or four months without any serious labour trouble, there will be a fair chance for improvement in the commerce of the country. This is rather a big "if" in these days, and one can only live in hope that more reasonable views will prevail in labour circles; for the trade of the United Kingdom is in no condition to bear any more burdens. The lessening of continental competition in iron and steel consequent upon the appreciation of the franc is something to the good; but unfortunately the position of the continental exchanges is still very precarious.

Metals.

The market for copper has not yet shown any decided tendency to advance, but, generally speaking, the situation seems to be rather more favourable. There has been rather more buying of copper lately for European account, and at the same time American producers are doing something to restrict the output. American consumption may perhaps not be all that was expected, but, on the whole, there is a diminution in the reserves of metals; and as the prices are still low, one would be inclined to think that there may be a fair chance for some rise in values. Consumers here do not seem yet to be buying very freely; and as the business in copper has been small for a long time, it is reasonable to suppose that the consumer is not now overburdened with stock. This, of course, is a favourable situation if confidence in values is again re-established. The official stocks of copper in this country are fairly large at 80,852 tons at the end of March, or nearly 1000 tons more than at the end of February; but this fact would not stand in the way of an advance if once people were convinced that there was no further probability of a fall in prices. The prices for manufactured copper and for brass and copper tubes are still maintained at what seems, to the consuming engineer, to be rather unnecessarily high levels; and perhaps this is one reason why consumers are disinclined to hold larger stocks of these materials. The demand for scrap copper, gun-metal and yellow brass is rather poor, as is evidenced by the low prices which scrap dealers are offering for these materials. For good gun-metal scrap few dealers now pay more than £48 per ton, and for heavy yellow brass scrap £40. The market for tin has not yet settled down, and rather large fluctuations are frequent. Movements of £5 to £8 per ton in a single day are common, and sellers here find that business is very difficult in consequence. The general belief here seems to be that tin will again advance to nearer £300, and this opinion does not seem to be shaken by the vagaries of the market. The statistical position seems to be rather favourable than otherwise, but the market is not living upon statistics at the present time. Lead and spelter have been rather steadier markets of late, but there does not seem to be any immediate probability of reaching the rather extravagant prices which ruled before the late slump in metals. There is, however, a good demand for lead, although the demand for spelter from the galvanisers is not now very good.

Pig Iron.

The better feeling in the iron centres of Glasgow and Middlesbrough have not altogether been without effect on the market for foundry iron in Manchester; and one notices a greater disposition on the part of buyers to do business. That foundry iron can be much, if anything, cheaper within the next three months seems far more improbable than it did a month ago. Then the fall in Cleveland iron was in full swing, and there had been a continuous drop of nearly 10s. per ton; and if there had come no check to the supply of cheap iron from the Continent it was possible that Cleveland iron might become cheaper than Midland iron in Manchester. Hence all serious buying here was postponed, awaiting events. Now the situation is quite different. Some of the Cleveland makers have advanced prices to 95s. per ton on trucks, which makes No. 3 iron from that district fully 5s. per ton dearer than the Midland irons. It is thought that a good deal of foundry iron is now wanted by Lancashire ironfounders, and there is no further good reason why they should delay purchases. Some of the Derbyshire makers are inclined to ask 1s. and 1s. 6d. per ton more for No. 3, but, as a rule, this iron can still be bought on a basis of 95s. per ton at the furnaces. Scotch iron is steadier here and some sellers are asking a little more than was the case last week; but there is no great difference in the situation.

Steel.

The steel trade has not yet felt much benefit from the improvement in the pig iron market. Steel-making irons are not in much request, because the makers of manufactured steel are still terribly short of orders. The demand in Manchester, both for plates and sectional

steel, is about as feeble as it well can be, and prices are very weak. It is hoped that we shall be spared any further trouble in the shipbuilding trade, but there was no need for a stoppage in that industry to make the demand for plates and angles worse than it is. Prices here remain nominally unchanged at £9 12s. 6d. to £9 15s. per ton for angles and £10 to £10 5s. for plates, but one continues to hear of steel plates at 5s. to 7s. 6d. per ton below the nominal prices.

Scrap.

There is perhaps rather a better inquiry here for foundry scrap, although it is difficult to be sure of this. Some dealers report rather more inquiry, but others still complain of the lack of business. If there should be an upward movement in foundry pig iron there might be a better disposition to buy what cheap scrap is offered. Broken machinery scrap at 87s. 6d. to 90s. per ton is certainly a very tempting item. Some holders of the best lots of textile machinery scrap are asking 95s.; but it can be bought at 92s. 6d. Heavy wrought scrap is quieter at 95s. to 100s. per ton; and heavy steel scrap of melting quality is neglected at about 72s. 6d. per ton on trucks at a Lancashire station.

The Engineers' Club, Manchester.

At the annual general meeting of members of the Engineers' Club, Manchester, held last week, Mr. John Taylor was re-elected president. To fill the vacancies on the committee Messrs. F. C. Hunt, R. B. Furnival, and J. B. L. Meek were re-elected, together with Mr. B. C. Stampe. Mr. J. Owden O'Brien and Mr. H. Richardson were re-elected honorary treasurer and honorary secretary respectively.

The Engineering Trades.

Although there are happily a few exceptions most of the engineering firms in this district complain that the slight improvement in trade which set in about the end of last year has not been maintained. The advent of the present Government had the effect temporarily of checking inquiries for new plant, and subsequently, just as confidence was about to be restored in the industrial world strikes, threats of strikes and demands for increased wages in nearly all branches of trade have "put the damper on" contracts which would otherwise have materialised. In addition to the threatened troubles in the shipbuilding and mining industries, Manchester has its own local labour difficulties to contend with. There is a strike amongst the corporation paviors and stone masons, which appears likely to extend to other classes of labour, and there is a demand by the tramway workers for increases of pay, as a result of the recent decisions in London. At a mass meeting of the tramway workers held on Sunday it was decided to ask for an increase of 8s. per week for all sections of workers.

The Institution of Electrical Engineers.

The twenty-fourth annual meeting of the members of the North-Western Centre of the Institution of Electrical Engineers was held at the Engineers' Club on April 1st, Mr. G. A. Juhlin presiding. The annual report states that the membership of the centre is made up as follows:—Members, 110; associate members, 396; associates, 13; graduates, 93; students, 411; making a total of 1023, compared with 965 last year. Mr. H. C. Lamb was elected chairman of the Centre for the coming year; Mr. A. B. Mallinson is the honorary secretary.

BARROW-IN-FURNESS.

Hematite.

The present state of the hematite pig iron trade is one of quietness, and the outlook is too clouded with labour troubles to permit anyone forecasting. There are only 10 furnaces in blast in the whole of the district, and all the present output is for sale, as there are no steel departments to take any just now. The furnaces are engaged on ordinary qualities of iron, but there is a likelihood of one being changed over to special in the course of a week or so. There is a fair amount of pig iron stocked by most works, and these stocks may increase in the early future. Customers are still confining their orders to immediate requirements, and this state of things is likely to continue for some time. The trade with America is very moderate, but this may increase, and there is a statement that the Continent is putting more inquiries through, but it is not known what these may lead to. The first step towards improvement will be the settlement of the coal miners' differences. Further, even if the Southampton strike is off there is the new demand on the part of shipbuilding workers for an increase, and until this is settled there will not be the confidence in the market that one would wish for. The prospect of any immediate improvement is remote. The Midlands and Scotland are the principal customers, but the tonnage does not bulk heavy.

Iron Ore.

The iron ore trade is worse if anything, and it will continue to be weak until there is an improvement in the iron trade. Many of the mines are restricted in their output, whilst others are almost idle. There is not a great deal going out of the district, and in view of there being only 10 furnaces in blast the requirements locally are small. The business done in foreign ore is small, and there will not be any improvement until the iron trade takes a decided turn for the better.

Steel.

The steel trade is worse than it has been for some time. The Barrow rail and merchant mills are still idle, and there is no talk of their re-starting, and in Workington a similar state of things obtains. The hoop and small section mills at Barrow are the only mills turning out material at present, and they are likely to continue as orders are held.

SHEFFIELD.

(From our own Correspondent.)

State of the Steel Trade.

There is an improvement in the condition of several departments of the steel trade, but it is not by any means general. On the basic side, things remain much as they were. Forward ordering is on a very limited scale, and, as a matter of fact, there is no great eagerness on the part of makers to sell far ahead at current quotations, which are not remunerative. The foreign competition to which I have referred several times during the past few weeks has fallen off, and is not considered likely to be as acute in the future as in the past, but the horizon is clouded by the labour uncertainties. On the acid steel side there is a better tone, the output having increased lately, largely owing to the orders for railway supplies. These orders are now beginning to be felt to the full extent. All the wagon shops in the country are engaged up to their full capacity, while every firm in this district which makes axles, tires, springs, buffers, rails and other material required by the railways is very busy. Valuable orders for high-class steel tubes have come to this district in connection with locomotive construction. The demand for steel for electrical engineering and motor building is well maintained. A good deal of activity prevails at the rolling mills.

The Lighter Side.

The old crucible steel trade of Sheffield keeps having little spurts of increased activity, and is enjoying one now, but it is only on a small scale, and on the whole the branch is very depressed. There are rather more orders on hand for the best tool steels. Dealers in alloys used in the manufacture of these expensive steels give anything but a cheering account of the state of their trade, and are unable to predict any early improvement. A good business is being done in farm and garden tools, while makers of contractors' tools are also well employed.

Rustless Iron Castings.

An interesting development in the use of stainless or rustless material is the production of castings of iron of this class by Samuel Osborn and Co., Limited, of Sheffield. These castings are said to differ from those of stainless steel in that they require no heat treatment. When de-scaled by sand-blasting and pickling, they are rustless without polishing. This means a considerable saving in costs of production. Messrs. Osborn are making these castings suitable for ornamental work, and also for engineering purposes, at a cost, I believe, of little more than double that of similar castings in brass.

Cutlery and Plate.

Although there is a large output of the cheaper qualities of goods in these trades, there has been such a great increase in the number of manufacturers during the last few years that the amount of business being offered is not sufficient to keep all employed, and in many cases small firms, lacking reserves of capital, are finding the problem of carrying on a very difficult one. There is very little demand for high-class goods. Some improvement is reported in the inquiry from seaside and other holiday and health resorts, and exports to several markets are mending.

Raising the German Fleet.

Some additional particulars are forthcoming with regard to the great task of raising the sunken German Fleet at Scapa Flow, which has been undertaken by Cox and Danks, Limited, of Sheffield. The preparations, on which the firm has spent nearly £30,000, are now nearly complete, and the salvage steamer Ferrodanks is making a series of journeys from Queenborough to Scapa Flow to transport the multifarious equipment that is required. A large ex-German floating dock, which the firm bought from the Admiralty, will be used for the lifting of the torpedo boats and other small craft. It is hoped that the dock will be ready for towing by the 19th inst., and its journey up to Scapa Flow will occupy a week. Once arrived on the scene, the dock will be cut into two parts, which will be stationed at either side of the vessel to be lifted. Powerful tackle, capable of lifting 4000 tons, will be built up on the two halves, and will be connected with steel ropes terminating in hooks, which divers will fix in the sides of the boat. The first of the sunken vessels to be dealt with will be a torpedo boat, which lies in 60ft. of water, and it is hoped that this will be raised within a fortnight of the actual start of the work. A different method will be adopted for the raising of the great battleships and cruisers. With them, after all the holes have been stopped up by divers, compressed air will be introduced. This process will, it is said, first be used in the case of the battle-cruiser Hindenburg, of 27,000 tons, which lies in 60ft. of water. It is hoped to have this great ship brought to the surface by the end of this year. The whole task of raising the fleet is one of such magnitude that it is not expected to be completed under seven or eight years.

A Mine Ventilation Research.

A piece of research work of exceptional importance has just been started by the Midland Institute of Mining Engineers, which operates in Yorkshire, with headquarters at Sheffield. Last year the Institute appointed a Committee to make an investigation into the question of the ventilation of coal mines, a subject which affords scope for much new study in view of the great development of deep mine workings which has taken place in the Yorkshire coalfield during recent years. At a meeting of the Institute last week the first fruits of the research were brought forward in the shape of two reports, by Professor Douglas Hay and Mr. Robert Clive respectively. Professor Hay dealt with "The Theory of Ventilation," and suggested the advisability of making some alteration in the generally accepted units in order to simplify and at the same time unify the treatment of problems in ventilation. Mr. Clive's report was on "The True Effect of Natural Ventilation in Deep Mines." He remarked that in older mines the effect of natural ventilation, although present, was usually small, and in many cases negligible, owing to the seams being comparatively shallow and the airways not particularly large, but in modern deep collieries with large shafts and large airways, the effect was appreciable. He went on to describe experiments, and to suggest new methods of calculation. The reading of the papers was followed by a discussion, in which several experts took part. The Institute intends to continue its work. The elaborate scale of the research is shown by the main heads on which the Ventilation Committee is working, namely, the enunciation of a modern theory of ventilation, equally applicable to fans and to underground roadways; limits of error in measurements under varying conditions, constants, &c.; survey of existing literature; the best method of use of the water gauge; collection of information from various collieries; relation between resistance of fan and resistance of mine; and many other matters. It is hoped eventually, after all the reports have been presented and fully discussed, to reduce all the material available to a single publication, which will be issued separately from the "Transactions" of the Institute.

Sheffield Bridge Scheme.

A number of bridge constructions and reconstructions are being carried out in Sheffield at the present time. The latest scheme to be launched is that of reconstructing bridges which carry Broughton-lane over the London and North-Eastern Railway and the Sheffield and South Yorkshire Navigation Company's canal. The Improvement Committee of the City Council recommends that the tender of John Wilson and Sons, of Birmingham, to carry out this work for £24,450, be accepted.

NORTH OF ENGLAND.

(From our own Correspondent.)

Improving Trade Prospects.

Notwithstanding the fears of fresh industrial troubles, quite an optimistic feeling has taken possession of the iron and steel trade. Recent transactions have been on a heavy scale, and a most encouraging feature is that purchasing has been general, including sales to France, Germany, Belgium, Italy and Scandinavia. A gradual growth of business is now anticipated with some confidence, if labour troubles do not hamper the position, as inquiries on both home and foreign account continue quite good.

Cleveland Iron Trade.

There is now a very healthy undertone in the Cleveland pig iron trade, and the general view is that if the price of No. 3 G.M.B. is stabilised at the present figure of 95s. per ton, a good steady business may be looked for. Most of the iron sold recently has, of course, changed hands at about 90s. per ton, and deliveries at this figure will probably continue for some time to come. But nothing below 95s. is now named, and if sales have shown a slight falling off, it is simply because consumers have covered their requirements for the time being. Even at the present figure, Cleveland iron is relatively cheap, so cheap, in fact, that continental consumers have been buying freely, and some big shipments will be recorded this month, transactions having been reported with all the near European countries. France can now buy Cleveland iron cheaper than she can produce her own, and the export position has consequently undergone a vast change. Home consumers are also watching the position closely, and recent heavy sales, no doubt, have been, in part, inspired by the fear of a rise in prices consequent upon dearer fuel. Whatever happens in regard to miners' wages, fuel must become dearer. Already, in fact, it is moving up, and consequently, pig iron cannot be any cheaper than it is at present. Makers are firm in their quotations of 100s. for No. 1, 95s. for No. 3 G.M.B. Cleveland pig iron, 94s. for No. 4 foundry, and 92s. 6d. to 93s. for No. 4 forge.

Hematite Pig Iron.

The East Coast hematite pig iron trade shows little change. There are still fair quantities of iron in stock, and this tends to keep the price at an unnaturally low level. But local hematite is now so much cheaper than French hematite that there should be a better market, and as soon as stocks are liquidated it seems likely that the price will go up, especially as present quotations are well below the cost of production. Makers are still offering mixed numbers at 99s. and No. 1 99s. 6d. to 100s. per ton.

Ironmaking Materials.

The foreign ore trade is still absolutely idle, consumers having large stocks and deliveries still coming forward under running contracts. No improvement in business is looked for until consumption shows signs of expansion. Best Rubio is nominal at 24s. per ton c.i.f. Tees. The fuel market is firmer all round, and some sellers of good medium Durham furnace coke are asking up to 32s. 6d. per ton delivered at the works. It is understood, however, that purchases might be made at 30s.

Manufactured Iron and Steel.

There is a rather better tone in the manufactured iron and steel trade, though business is still on the slow side. The threat of the shipyard lock-out is a disturbing factor. The demand for constructional steel shows a slight improvement, and a few orders are reported for railway material. Galvanised sheets are cheaper at £17 15s. to £18 for 24in. gauge, and there is a good demand for black sheets, 24in. gauge, at £13 10s. per ton. Other quotations are unchanged.

The Coal Trade.

There is very little movement in the Northern

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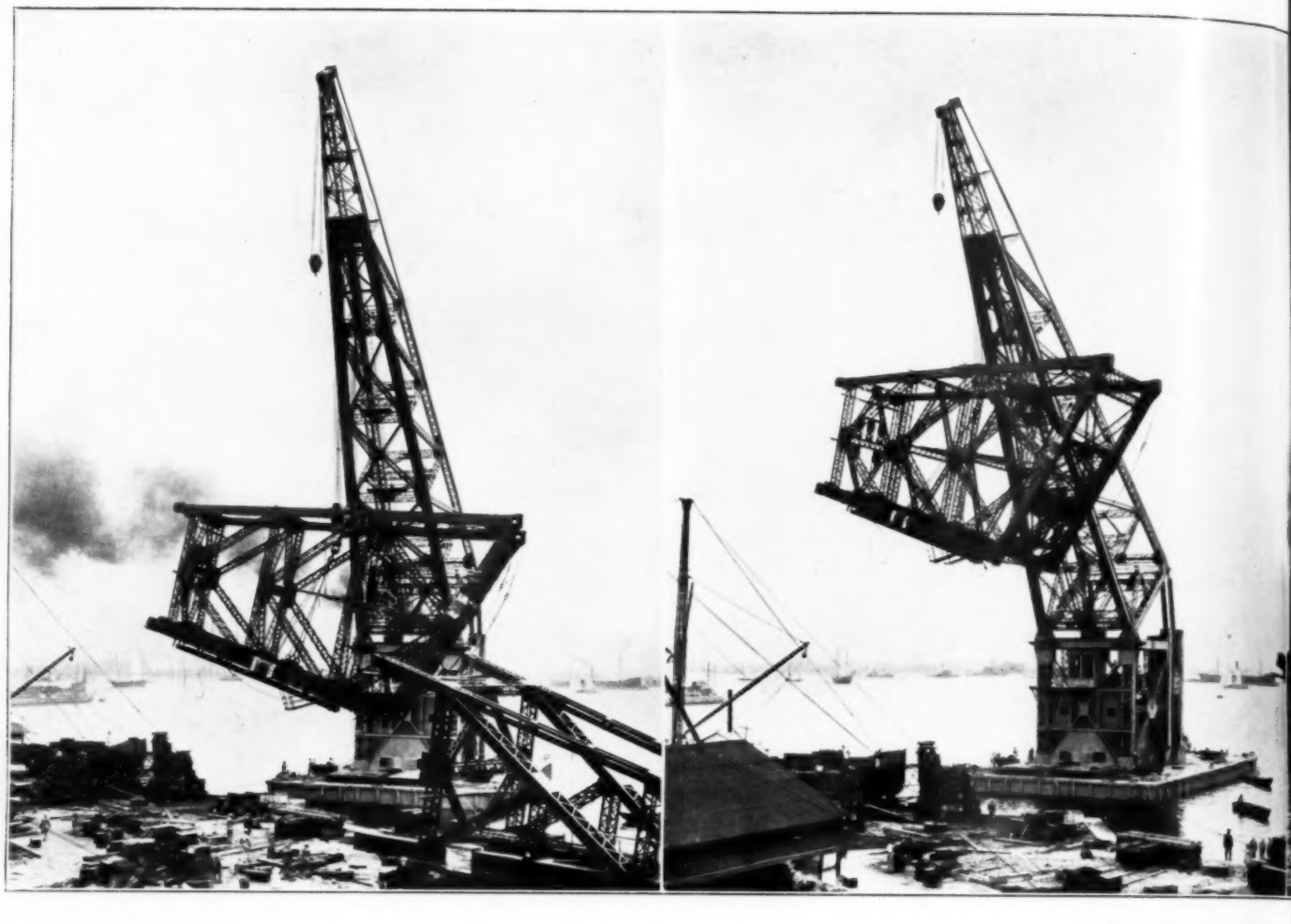

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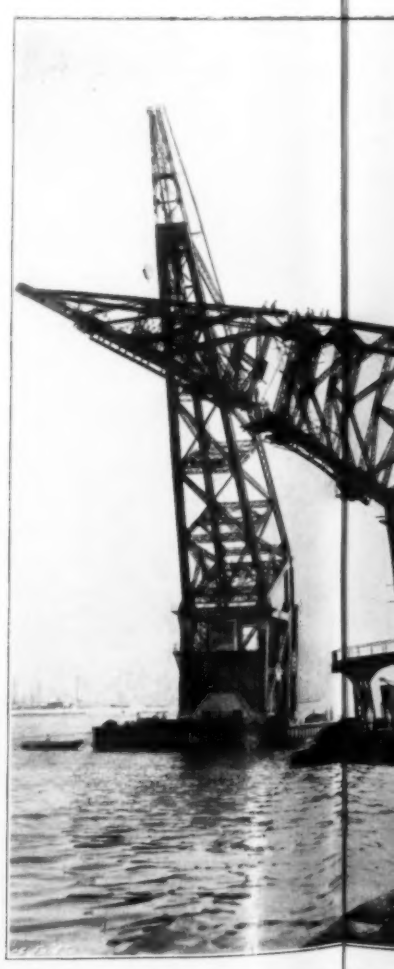

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coal trade just now, but this is solely due to the difficulty in securing supplies. Coal fitters report that they are entirely sold out to Easter and overstemmed with tonnage, while for later loadings offers fail to bring business. The position is thus irregular, but strong up to Easter, owing to labour troubles, and prices for this period rule at high figures, but sales are limited to odd parcels. For forward the inquiry is good, but merchants continue to hold off until the result of the miners' ballot is known. The outlook, of course, is irregular through the labour unrest, but given steady working, merchants generally anticipate a good summer trade. France, Italy and Scandinavia are all inquiring freely. Reasonably moderate prices only are needed to give a fillip to business. Italy, despite getting ample supplies of reparation coals, is still a substantial buyer of British coals, and locally merchants do not greatly fear German competition under the present ruling circumstances. Incidentally, shipowners call attention to the marvellously quick dispatch obtainable at Rotterdam in loading coals as compared with Tyne docks. From the former, 1200 to 1500 tons per day is the guarantee, but in actual practice double that quantity is found to be the possibility. Thus a large boat is loaded in thirty-six to forty-eight hours, as against many days required at the Tyne berths. Great activity is the rule in the Northumberland steam coal section, the whole of the output of the collieries being immediately taken up. Prices of all qualities are firmly maintained. Durham gas coal collieries are also well situated in regard to contracts to the end of the month, and there is keen competition for any quantities coming on to the market. The pressure for coke deliveries during the present fortnight is keen, and prices consequently are firm, but for next month there is little pressure, and prices, though unchanged, are nominal.

Blast-furnacemen's Wages.

The ascertainment issued by the Cleveland Ironmasters' Association certifies that the average net selling price of No. 3 G.M.B. Cleveland pig iron for the past quarter was 95s. 8.94d. per ton. Under the sliding scale, the wages of blast-furnacemen on the North-East Coast will be advanced by half of 1 per cent., their wages being raised from 27½ to 28 per cent. above the standard. The advance dates from April 6th.

SCOTLAND.

(From our own Correspondent.)

Idle Markets.

THE uncertainty in trade circles generally, in view of the labour unrest, is reflected in the extremely dull nature of the steel and iron markets. It appears reasonably certain that, given security of occupation for a considerable period, orders would be forthcoming in sufficient bulk to cause at least a fair measure of activity all round. Orders are being held up, and even although everything points to increased costs in the future, buyers are not purchasing anything beyond their immediate—in fact, sometimes their daily—requirements. Therefore, while shipbuilding and engineering contracts have been reported from time to time, the contracts for material involved have either not yet been given out or specifications are filtering through very slowly indeed. Consequently new business in steel plates, &c., continues on a very small scale, and meanwhile on-costs, in the nature of coal fuel and other items, are increasing. Official prices are unchanged, but it is said that under special circumstances and for certain quantities, makers are allowed to meet outside competition. On the whole, however, the markets are in a state of comparative idleness.

Oban Mines Reopened.

The Tyndrum zinc and lead mines at Oban have just been reopened. A number of workers have been engaged, and their number will be added to. The Tyndrum lead mines are famous for their quality, while the stratum continues westwards among the Strontian hills, a district rich in strontium mica, lead, felspar and other minerals.

New Contracts.

John Brown and Co. Limited, Clydebank, have received an order for a large oil tank vessel to be fitted with internal-combustion engines. The Mirrlees Watson Company, Glasgow, is to make the condensing plant in connection with the supply of electrical machinery, at Carlisle generating station, while the travelling crane for the same enterprise is to be furnished by Alexander Jack and Co., Motherwell. Messrs. Alexander Finlay and Co., bridge builders, Motherwell, have secured a contract to construct a steel underline bridge and cylinders on the Great Northern Railway of Ireland system.

Pig Iron.

The pig iron market is inactive but fairly steady in tone. Continental competition is not so prominent, and inquiries at home and abroad are on the increase. Business under present conditions, however, is well-nigh impossible.

Steel Sheets.

The export demand for steel sheets is fairly regular, but is chiefly concerned with light varieties. Heavy gauges are extremely slow. Home demands generally are far below normal. Galvanised descriptions are receiving a little more attention, but easier prices are looked for.

Coal.

The coal market is dominated, more or less, by the labour uncertainty. Opinions as to the outcome of the present negotiations are very divided, and the proceedings in the market are extremely cautious. Another ruling circumstance is the shortage of prompt fuel. The collieries in all districts are well booked up and have really nothing in the way of round fuel to offer for immediate sale, and, of course, forward business is next to impossible. Immediate foreign demands have not been particularly heavy, but any lack here has been amply made good by the insistent call for coal for inland purposes. All grades of fuel have been in eager demand, despite rising prices, and with selling being mostly of a day-to-day description and chiefly of second-hand lots, keen competition for available lots has been experienced. Shipments for the week amounted to 318,853 tons, against 145,545 tons in the preceding week, and 386,579 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THERE is a distinctly better outlook in the coal trade from the labour point of view, though the business side leaves much to be desired. Doubtless, until the position becomes more defined as regards the question of a strike or otherwise, there will be very little done on the part of buyers abroad in respect of further supplies of coal, but it is now a fact that the preponderating view is that the coalowners and the miners' leaders will come to a settlement, though it may take another week or two to arrive at this desirable end. It is stated as a matter of fact that it was only by one vote that the M.F.G.B. Executive did not accept the coalowners' offer, and, further, that the Executive cut its last proposal down to 35 per cent. increase on the 1914 wage rate as a form of compromise, so that there was left at the most a difference of 2½ per cent., as compared with the coalowners' offer. It is furthermore very significant that the South Wales delegate conference which met on Saturday last to consider the position and make recommendations to the workmen adopted a very mild attitude. It was fully expected that a more hostile attitude would have been displayed towards the coalowners' proposals, and that the rank and file members would have been recommended to vote against the acceptance of the terms; but no such course was taken. Instead of this, the delegates, after hearing explanations from their representatives on the M.F.G.B. Executive and discussing at length the situation, simply passed a resolution that no recommendation for rejection or acceptance should be made, and it was left to the delegates to convey to the workmen before the ballot the information which had been given at the conference. The more responsible leaders, such as Mr. T. Richards, the acting President of the Miners' Federation of Great Britain, and Mr. Enoch Morrell, the South Wales President, strongly advocated the acceptance of the coalowners' offer, while the opposition came principally from the leaders of the South Wales Miners' Minority Movement, who, however, could not give a very convincing answer to the question as to what the miners were likely to gain by rejecting the coalowners' terms. On the other hand, those who supported the acceptance of the terms pointed out that the miners had nothing to gain and much to lose by rejecting them. The ballot, of course, took place on Tuesday, but although the figures are not available, it is believed that those for and against the coalowners' terms are fairly evenly balanced.

LATER.

Up to-Wednesday afternoon the ballot returns showed that 45,291 had voted for accepting the owners' offer and 74,976 for rejection, the majority for rejection therefore being 29,685.

Foreign Demand.

Unfortunately, the uncertain conditions prevailing are continuing to be highly detrimental to business operations, and it is very discouraging to see the abnormally heavy shipments which are still being made of American and German coals to various continental destinations, principally Italy and France, while American coals are going in fairly large quantities to South American ports. Shipments of German coals are proceeding with great activity from Rotterdam, where they guarantee to load steamers of 6000 tons in two days. Offers of German coals are being received everywhere, and quite recently one Cardiff firm of shipbrokers had twenty-one steamers diverted to load at Rotterdam that would in normal conditions have come to this district. Apart from American cargoes coming to European ports, the Americans are seriously cutting into the South American markets. Since February 1st, 165,000 tons of American coal have been discharged into Rio de Janeiro, Monte Video and other River Plate ports, whereas in ordinary circumstances the quantity is comparatively small. The only inquiry which has come along of late is one from the Egyptian State Railways, which have asked for tenders for 150,000 tons of Welsh coals, the delivery of which is to commence in June next. Tenders for this business have to be received at Cairo on May 14th next. It will be recalled that not long ago the Egyptian State Railways came on the market for 200,000 tons, but only purchased 50,000 tons on a f.o.b. basis, and deferred buying the balance of 150,000 tons. Apart from this inquiry, there is very little activity as regards new business, and the general belief is held that a quiet time will be experienced for some time, more especially as foreign coal depôt owners have taken the precaution of filling up their depôts, and in the event of there being no strike, will not require supplies for a few weeks at least.

Third Shift Working.

During the past week or two negotiations have been in progress in order to secure the reintroduction of the partial third shift at South Wales ports, and last week-end Cardiff, Penarth, Barry and Newport tippers met to consider the position and the offer which had been made to them by the Great Western Railway Company. The result of the meeting was that the tippers decided to defer any further consideration of the third shift for a period of twelve months. The effect of this decision is that the offer of the Great Western Company has been rejected, and unless further steps are taken to reopen negotiations, nothing will be done in the way of night work for twelve months. The workmen have certainly taken a very strong line, their contention being that all the coal required for shipment can be handled in the present two shifts. They may be right so far as the summer months are concerned, but past experience has shown that there is no margin for any extra pressure that may fall upon the industry, such as has been the case during the past month or two, and was very much in evidence during the latter months of last year.

Cardiff's Shipowners.

According to a statement issued by the Shipping Federation, Limited, the local members of the Federation own 364 vessels with a gross tonnage of 1,004,078 tons, while a year previously the number of steamers was 361, of a gross tonnage of nearly 900,000 tons. The list issued, however, by the Federation does not altogether accurately represent the tonnage owned in this district, as there are a few shipowners who are not members of the Federation. The list shows that Sir William Reardon Smith and Sons are the managers of the largest fleet of steamers, the number being twenty-eight, of 144,470 gross tons.

Current Business.

The tone of the steam coal market is not quite so strong as a week ago, and this is doubtless due to the fact that while the outlook for a settlement of the miners' demands is more hopeful, the inquiry for coals is distinctly quiet, and it is not unlikely that orders will be wanted for early May shipment. The majority of qualities are very tight for loading before the Easter holidays, but it is after then that it is expected that the weakness will develop. This will in all probability be contributed to by the shortage of prompt tonnage. So many shipowners have taken the precaution of sending their steamers away from this district for fear that there might be a stoppage in the coalfield that it is probable that supplies of tonnage will be scarce. Anthracite coals show very little change, and remain very steady, with some grades, such as beans and peas, extremely difficult to obtain for early shipment.

Miners' Holidays.

IT has been arranged that the South Wales miners shall have two days' holiday at Eastertide, *i.e.*, Easter Monday and Tuesday, and that the night men shall resume work on Tuesday night, otherwise they will forfeit the proportionate part of the bonus turn and the subsistence wage. Tippers and trimmers at South Wales ports will work on Easter Tuesday.

CONTRACTS.

THE UNDERFEED STOKER COMPANY, Limited, has recently received orders for (*a*) a total of forty-one travelling grate stokers, (*b*) ten Underfeed stokers, (*c*) an air heater, (*d*) two pulverised fuel plants, (*e*) ash conveyors, and (*f*) suspended arches for four separate boiler plants.

VICKERS, Limited, Barrow-in-Furness, have secured the order for a second unit for the Holborough Cement Works, Halling, Kent, comprising a large rotary kiln and cooler, and all subsidiary machinery, including electrical equipment manufactured by the Metropolitan-Vickers Electrical Company, Limited.

WE are informed that, for the purpose of obtaining daylight effects in the new aquarium under the Mappin terraces at the Zoological Gardens, Siemens daylight electric lamps have been installed with successful results. The tanks on the inner side of the gallery are illuminated with the same firm's gas-filled daylight lamps, the glass bulbs of which are selectively tinted so that the light may closely approximate to daylight. This arrangement has been so effectual that plants and fish, it is stated, flourish as well in it as in natural daylight.

MELDRUMS, Limited, of Timperley, inform us that in the first three months of this year forty-three boilers of various types have been fitted with their forced draught furnaces and for mechanical stokers; that they have supplied fifteen refuse destructors, some for incineration only, others with water heaters or boilers for heat utilisation; thirteen sets of portable steam disinfectors for the War Office, Crown Agents for the Colonies, &c.; and chemical plant in "Meldrum" acid-resisting and other metals, including centrifugal pumps, cocks and valves, steam jet appliances, &c.

ED. BENNIS AND CO., Limited, inform us that for the six months ending March 31st they have received orders as follows:—(*a*) For electric generating stations: fourteen chain grate stokers and relinking two grates of another make; two sprinkler stokers for Lancashire boilers; and three independent coal elevators and complete coal and ash equipment (including truck tipplers) to deal with sixteen water-tube boilers. For collieries: twenty-eight sprinkler stokers; one scroll conveyor; and two independent coal elevators. For textile mills, &c.: sixty-four sprinkler stokers for Lancashire boilers; two hand-fired furnaces; relinking one chain grate of another make; coal and ash-handling plant for four boilers; one independent coal elevator; one rotary truck tippler; and one 40-ton coal bunker; and for miscellaneous works: sixteen sprinkler stokers; six coking stokers; coal-handling plant for four water-tube boilers; and coal and ash-handling plant for eight water-tube boilers.

BRITISH SUGAR BEET.—The ninth annual meeting of the British Sugar Beet Society, Limited, was held at the Hotel Victoria, London, on the 9th inst., when Lord Ailwyn was elected president for the ensuing year. The Mason Cup was presented to Mr. G. Caudwell, of Weston, Spalding, whose crop showed an average yield of 16 tons 3 cwt. 1 qr. per acre, and an average sugar content of 15.9 per cent. Though better yields and sugar contents have been obtained in previous years, these figures were considered to be very satisfactory, having regard to the climatic conditions which prevailed during the past season. The meeting was followed by a luncheon, at which the Minister of Agriculture, the Rt. Hon. Noel Buxton, was the principal guest. In proposing the health of the Society, the Minister expressed the keen interest which the present Government took in the sugar beet industry in this country, as it felt that, not only did it conduce, in a remarkable degree, to retaining and extending the amount of arable land, but gave the continuous employment, which was so much needed, to agricultural labour. He was unable, he said, to anticipate the Chancellor of the Exchequer, but could say that the Government recognised that what the industry wanted was continuity of policy, and promised that it would give that aspect of the question its sympathetic consideration.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	19/6 to 26/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	24/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 2 6	—
No. 1 Foundry	5 5 0	—
No. 3 Foundry	5 0 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 19 0	4 19 0
No. 1	5 0 0	5 0 0
Cleveland—		
No. 1	5 0 0	5 0 0
Silicious Iron	5 0 0	5 0 0
No. 3 G.M.B.	4 15 0	4 15 0
No. 4 Foundry	4 14 0	4 14 0
No. 4 Forge	4 13 0	4 13 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 7 6 to 4 10 0	
,, ,, Foundry	4 15 0	—
(3) Northampton—		
Foundry No. 3	4 12 6	—
,, Forge	4 5 0	—
(3) Derbyshire—		
No. 3 Foundry	4 15 0	—
Forge	4 7 6	—
(3) Lincolnshire—		
No. 3 Foundry	4 14 6	—
No. 4 Forge	4 13 0	—
Basic	4 11 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 15 0 (a) / 6 0 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 10 0	—
Best ,,	—	—
N.E. Coast—		
Common Bars	12 0 0	—
Lancs.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 10 0 to 13 0 0	
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	11 12 6 to 11 15 0	
Gas Tube Strip	13 0 0 to 13 5 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 10 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 5 0†	—
Light ,,	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Manchester—		
Bars (Round)	10 0 0 to 10 5 0	
,, (others)	9 15 0 to 10 2 6	
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
,, (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
Midlands—		
Small Rolled Bars	9 15 0 to 10 10 0	
Billets and Sheet-bars	8 0 0 to 8 10 0	
Gas Tube Strip	10 15 0 to 11 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 15 0 to 18 0 0	
Angles	9 15 0 to 10 0 0	
Joists	9 15 0 to 10 0 0	
Tees	10 15 0 to 11 0 0	
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	24/6 to 24/9
Block Tin (cash)	259 10 0
,, (three months)	258 10 0
Copper (cash)	64 0 0
,, (three months)	64 17 6
Spanish Lead (cash)	33 17 6
,, (three months)	32 12 6
Spelter (cash)	33 5 0
,, (three months)	33 5 0
Manchester—	
Copper, Best Selected Ingots	69 10 0
,, Electrolytic	71 0 0
,, Strong Sheets	98 0 0
,, Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0¼
,, Condenser	0 1 2½
Lead, English	35 10 0
,, Foreign	34 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
,, 6 p.c. to 8 p.c. ,,	£23 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£22 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£45 0 0	16/-
,, ,, 1 p.c. ,,	£51 0 0	17/6
,, ,, 0.75 p.c. carbon	£68 0 0	20/-
,, carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 5 0	scale 5/- per unit
,, ,, 75 p.c.	£17 0 0	scale 6/- per unit
,, Vanadium	19/6 per lb.	
,, Molybdenum	8/6 per lb.	
,, Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£130	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	26/9
,, ,, Ell	28/6
,, ,, Splint	28/- to 30/9
,, ,, Trebles	26/-
,, ,, Doubles	25/9
,, ,, Singles	22/9
Ayrshire—	
(f.o.b. Ports)—Steam	26/9
,, ,, Splint	28/6
,, ,, Trebles	26/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	22/9 to 25/-
Screened Navigation	31/-
Trebles	28/6
Doubles	25/-
Singles	22/9
Lothians—	
(f.o.b. Leith)—Best Steam	24/9
Secondary Steam	23/9
Trebles	26/3
Doubles	25/-
Singles	22/9

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	31/-
Household	49/- to 59/-
Coke	38/6
Northumberland—	
Best Steams	27/- to 27/6
Second Steams	26/-
Steam Smalls	16/-
Unscreened	23/6 to 24/6
Household	26/- to 28/-
Durham—	
Best Gas	25/6
Second	24/- to 24/6
Household	26/- to 28/-
Foundry Coke	30/- to 32/6
Sheffield—	Inland.
Best Hand-picked Branch	36/- to 39/- —
Barnsley Best Silkstone	34/- to 36/- —
Derbyshire Best Brights	31/- to 35/- —
,, ,, House	27/- to 29/- —
,, ,, Large Nuts	27/- to 28/- —
,, ,, Small ,,	20/6 to 23/- —
Yorkshire Hards	27/- to 30/- —
Derbyshire ,,	25/- to 28/- —
Rough Slacks	12/6 to 15/6 —
Nutty ,,	12/- to 14/- —
Smalls	8/- to 10/- —
Blast-furnace Coke (Inland)	29/-
,, ,, (Export) f.o.b.	31/- to 32/-

(9) SOUTH WALES.

	Cardiff—	Swansea—
Steam Coals:		
Best Smokeless Large	31/6 to 32/6	
Second ,, ,,	30/- to 31/-	
Best Dry Large	29/- to 30/-	
Ordinary Dry Large	27/- to 29/-	
Best Black Vein Large	30/- to 31/-	
Western Valley ,,	29/- to 30/-	
Best Eastern Valley Large	28/6 to 29/6	
Ordinary ,, ,,	27/6 to 28/6	
Best Steam Smalls	22/6 to 23/6	
Ordinary ,,	20/6 to 22/6	
Washed Nuts	28/- to 30/-	
No. 3 Rhondda Large	30/- to 31/-	
,, ,, Smalls	25/- to 26/-	
No. 2 ,, Large	25/- to 26/-	
,, ,, Through	21/- to 23/-	
,, ,, Smalls	19/- to 20/-	
Coke (export)	55/- to 60/-	
Patent Fuel	29/- to 32/-	
Pitwood (ex ship)	25/- to 26/-	
Swansea—		
Anthracite Coals:		
Best Big Vein Large		42/6 to 45/-
Seconds		40/- to 42/6
Red Vein		32/6 to 35/-
Machine-made Cobbles		50/- to 52/6
Nuts		45/- to 55/-
Beans		47/6 to 50/-
Peas		29/- to 31/-
Breaker Duff		13/- to 13/3
Rubbly Culm		16/6 to 17/-
Steam Coals:		
Large		24/6 to 26/6
Seconds		22/- to 24/-
Smalls		15/- to 18/-
Cargo Through		19/- to 22/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

† Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Free Exports.

THE situation of iron and steel firms has not been improved by the appreciation of the franc, which has had the effect of diminishing the foreign demand and of facilitating foreign competition in this market, with the result that producers are displaying much more eagerness to secure orders. They are unable yet to offer any notable reduction in prices, and consumers hesitate to purchase, in view of the uncertainty that prevails with regard to the future. The uncertainty is particularly prevalent amongst mill and forge owners and engineering firms, which find that the foreign markets are becoming more and more restricted by the development of the metallurgical industry abroad, and there is a good deal of speculation just now as to whether this country, which has become the largest producer of raw iron and steel on the Continent, should be content to export the raw material or should work up as much of it as possible for foreign requirements. It is argued that producers should not be allowed to send their material abroad at below the prices home consumers are obliged to pay. During the past two months the depletion of the stocks of pig iron and of partly manufactured material on export account caused serious embarrassment to home buyers, and if manufacturers are to work up the material for export they do not expect to be placed in a more unfavourable position than their foreign competitors. There is even a question of returning to the bounty system, which already exists to a certain extent, on manufactured goods sent abroad, but some prudence is being exercised in view of the anti-dumping laws that are in operation in certain countries. Another factor in the development of the export trade is the action of the new Government in repealing all the prohibition measures, with the exception of those relating to foodstuffs. Those measures were strongly objected to by manufacturers, who affirm that they have given no practical results and have been merely a serious hindrance to liberty of trade.

Paris Water Supply.

With a view of impressing upon the Municipal Council the necessity of putting in hand some of the schemes for bringing additional water to Paris, M. Lemarchand has distributed amongst the members a particularly full historical account of the Paris water supply from the earliest times. At present about 2,000,000 cubic metres of water are distributed daily in Paris and the Department of the Seine. Not only is this amount barely sufficient in normal times, but the Paris mains are not large enough for the distribution, and M. Lemarchand estimates that at the present rate of progression, the requirements at the end of another twenty years will be not less than 4,000,000 cubic metres. Consequently, a great deal of expenditure will have to be made upon increasing the capacity of the Paris mains, while it is highly desirable to lose no time in carrying out some of the new schemes for providing the city and the department with an adequate supply of water for future requirements. On account of the policy of retrenchment being adopted by the Government, the Municipal Council has been authorised to spend only what is barely sufficient to continue the works from the Durteint and the Voulzie, and it is probable that the completion of the undertaking will necessitate a heavy additional expenditure. Under the circumstances, the other schemes are being left in abeyance. For that reason, M. Lemarchand is calling attention to the serious trouble that may be occasioned eventually by a failure to prepare the way at once for the execution of some of the proposals for supplying water to the city.

Railway Electrification.

The Paris-Orleans Railway Company possesses its own hydraulic concessions on the Upper Dordogne and elsewhere, and a considerable sum of money is being devoted to the construction of hydro-electric installations, transforming stations and the laying down of high-tension mains with a view to the electrification of the entire system. It is expected that the power station at Coindre will be in operation at the end of 1926, and the one at La Celette a year later, while it is hoped that the powerful station at Eguzon, on the Creuse, will be ready at the end of next year. The 90,000-volt mains from Paris to Orleans will be completed towards the end of this year, and the 150,000-volt mains from Eguzon will reach Vierzon a few months later. The first section to be electrified will be from Paris to Vierzon, and eventually at Brive and Clermont. Another section will be from Saint-Sulpice to Montluçon and Gannat.

Engineering Works.

Although it has been decided to suspend the carrying out of new public works until the country's financial situation is more satisfactory, there continues, nevertheless, to be a fair amount of work in connection with the undertakings already in hand, and it is evident that the competition for such business is keener than it has been for a long while past. There is some activity on account of the colonies, where harbour works and railway construction are necessitating the employment of a fair amount of material. In Indo-China a contract was recently given out for twenty-five small bridges for the Annam Railways. In West Africa also railway construction, although greatly retarded by financial limitations, is being continued without interruption. At home a great deal of activity is being shown in improving port equipments. The Chamber of Commerce of Nantes has been authorised to spend 15 million francs upon the completion of the new wharf, which will have a length of 1701 m. The steam cranes, which were imported from the United States during the war, are being replaced by electric cranes. Nantes is hoping to develop considerably as a shipping centre, when the carrying out of the scheme for deepening the Loire and for constructing waterways in connection therewith allows of cheap and direct transport from Lyons and other industrial centres in the Department of the Loire.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

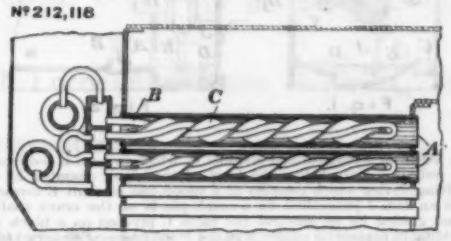
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

212,118. March 12th, 1923.—IMPROVEMENTS IN STEAM SUPERHEATERS FOR STEAM BOILERS, Edward Arthur Geoghegan and Milton Kraemer, both of 350, Madison-avenue, New York.

In the smoke tubes A twisted return superheater tubes B are

Nº 212,118



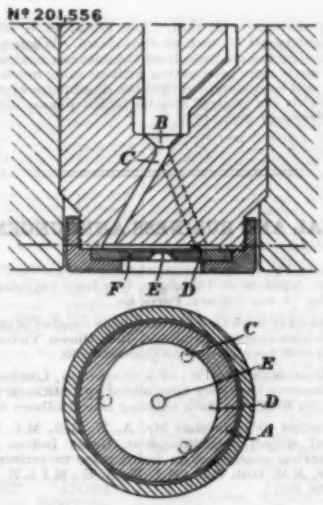
placed, and between these superheater tubes there are twisted metal strips C. The open ends of the superheater tubes are connected to headers as shown.—*March 6th*, 1924.

INTERNAL COMBUSTION ENGINES.

201,556. July 24th, 1923.—IMPROVEMENTS IN OR RELATING TO FUEL ATOMISERS FOR INTERNAL COMBUSTION ENGINES, Aktiebolaget Atlas Diesel, of Torsgatan 5, Stockholm, Sweden.

The atomiser consists of a non-adjustable body A and the fuel valve B, which regulates the flow of fuel to the fuel channels C. The channels C start from the centre of the body and open at the periphery of the intermediate chamber D provided with an outlet opening E and are arranged so as to form an angle with the bottom of the chamber D. For obtaining a high degree of atomising of the fuel the height of the chamber D at the opening E is dimensioned so that the distance from the inner edge of the opening E to the upper wall of the chamber D is at most equal

Nº 201,556



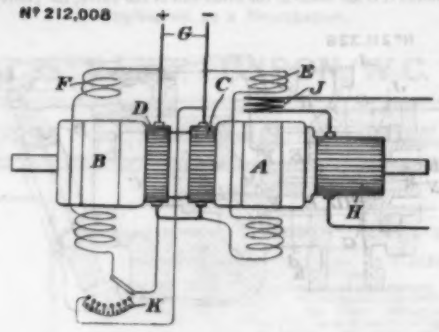
to or preferably smaller than the radius of the opening E. As the opening E in smaller engines up to 25 horse-power has a very small radius, about 0.3 mm., the height of the intermediate chamber will consequently be very small. The reason why the fuel becomes atomised in a high degree is that the fuel is forced to the opening E from all directions, so that partly by the shock of the fuel particles against one another and partly by the sudden change of their direction of movement at the opening E the fuel is atomised so as to form a very fine spray. The bottom of the chamber D consists of a disc F of a very hard material, such as tempered steel or a hard mineral, which is held in position by means of a nut. The outlet opening E is provided in the disc.—*March 6th*, 1924.

DYNAMOS AND MOTORS.

212,008. December 20th, 1922.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINES, The British Thomson-Houston Company, of Crown House, Aldwych, and Alan Adair Pollock, of 27, Milverton-crescent, Leamington Spa.

This invention relates to systems of and apparatus for electric distribution and more particularly to systems such as are used on electric railways where the supply voltage may be much higher than is desired for lighting or for operating the control gear, ventilating fans, heating devices, or the like. As shown in the diagram, a machine with two armatures is provided, the armature A having a commutator C and the armature B a commutator D. The armature A has a magnetic circuit of high flux density, whereas the armature B is arranged to run at low flux density. The armature A is provided with a field E and the armature B with a field F, both these fields being excited from their own armatures. The high-voltage supply circuit is marked G. With this arrangement practically the whole of the variations of the supply circuit will be taken by the armature B, whilst the voltage across the armature A remains substantially constant, and it is therefore possible to use this voltage for lighting, &c., provided the voltage required on the lighting circuit is of a suitable value compared to that of the track voltage. If, however, the lighting voltage is low compared with the track voltage, a

Nº 212,008

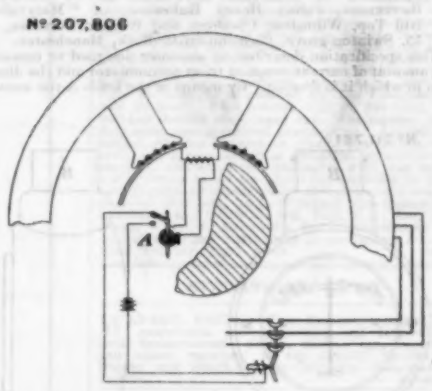


second winding is placed on the armature A and is connected to a commutator H. J is a compounding winding and K a starting resistance.—*March 6th*, 1924.

207,806. December 2nd, 1922.—IMPROVEMENTS RELATING TO DYNAMO-ELECTRIC MACHINES, *Metropolitan-Vickers Electrical Company, Limited*, 4, *Central-buildings, Westminster*.

According to this invention, a time relay device A operated by the current flowing in the amortisseur winding completes

Nº 207,806



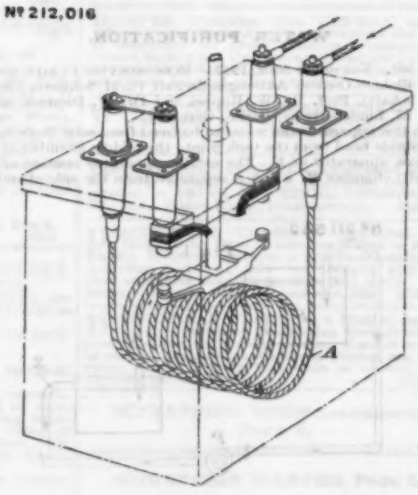
auxiliary circuits when a predetermined current has passed for a predetermined time interval through the amortisseur windings. The time interval is preferably adjusted to be equal or nearly equal to the time interval in which the machine can be accelerated from rest to synchronous speed under normal conditions.—*March 6th*, 1924.

SWITCHGEAR.

212,016. December 20th, 1922.—IMPROVEMENTS IN OR RELATING TO ELECTRIC CIRCUIT BREAKERS, David Reginald Davies, of 85, Cyprus-street, Stretford, Manchester, and the Metropolitan-Vickers Electrical Company, Limited, of 4, Central-buildings, Westminster.

According to this invention, the reactance coil A, which is included in series in the circuit to be protected, is so arranged with reference to the circuit breaker contacts that the magnetic

Nº 212,016



field of the reactance coil acts as a magnetic blow-out for the arc which is formed at the circuit breaker contacts at the time of breaking and also accelerates the movement of the movable part of the circuit breaker when breaking the circuit. Where the circuit breaker is of the kind in which the contacts are immersed in oil contained in a tank, the reactance coil may advantageously be arranged in the tank as shown.—*March 6th*, 1924.

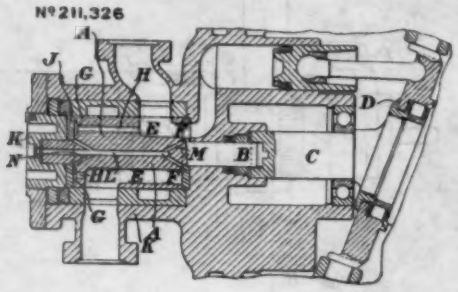
PUMPING AND BLOWING MACHINERY.

211,326. January 30th, 1923.—IMPROVEMENTS IN ROTARY VALVES FOR ENGINES AND PUMPS, Sir W. G. Armstrong, Whitworth and Co., Limited, Hugh Warren Lee, and Francis Philip Fee, all of Elswick Works, Newcastle-upon-Tyne.

This invention relates to rotary valves of engines or pumps in which the working fluid is supplied to the valve in a direction transverse to its axis and passes through ports at the end of the valve to ports of the engine or pump cylinders, and particularly to hydraulic swash plate engines or pumps. The object

is to balance the axial thrust on the rotary valve. A is a rotary cylindrical valve connected by a coupling B to the shaft C of a swash plate D. The working fluid passes through passages E E, which are controlled by valve ports F F at the end of the valve. Grooves G G are made in the other end of the valve, the grooves

No 211,326



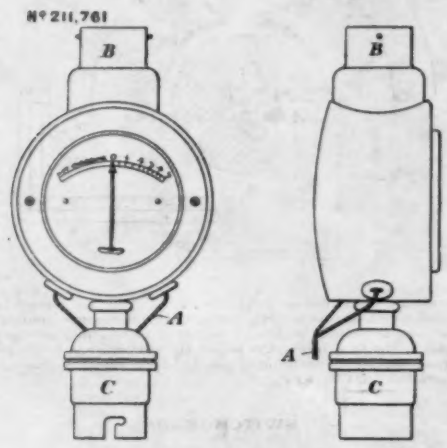
being connected to the valve ports F F by holes H. A washer J is inserted between the end of the valve A and the end of its casing K. A hole L having bifurcated ends M extends from one end of the valve to the other, and other holes N extend from the hole L towards the washer *J*.—*February 21st*, 1924.

MEASURING AND TESTING INSTRUMENTS.

211,761. May 3rd, 1923.—An Improvement relating to the Charging of Electric Accumulators or Storage Batteries, Julian Henry Rubraken, of "Maryvale," Hill Top, Wilmslow, Cheshire, and William Torrance, of 53, Swinton-grove, Chorlton-on-Medlock, Manchester.

This specification describes an ammeter designed to measure the amount of current supplied to an accumulator and the direction in which it is flowing. By means of the leads A the instru-

No 211,761



ment is coupled with the battery being charged. The instrument is provided with a plug B to engage with the supply socket and also with a socket or holder C for a lamp to illuminate the dial. The dial is graduated at one side of a central zero. When the needle is on that side the readings show a flow of the current in the correct or charging direction. The movement of the pointer to the opposite side of the zero indicates that no charge is passing into the accumulator.—*February 28th*, 1924.

WATER PURIFICATION.

211,562. November 20th, 1922.—Electrolytic Purification, Elektro-Osmose Aktiengesellschaft (Graf Schwerin Gesellschaft), Prof. Dr. W. Ruppel and Dr. W. Dietrich, all of 35, Lindenstrasse, Berlin, Germany.

In this apparatus the water to be freed from salts flows under a suitable head from the tank S into the middle chamber of the osmose apparatus at E. The osmose apparatus consists of the middle chamber M, which is separated from the side chambers

No 211,562

Fig. 1.

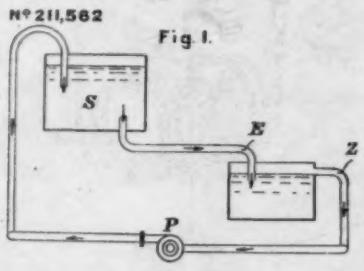
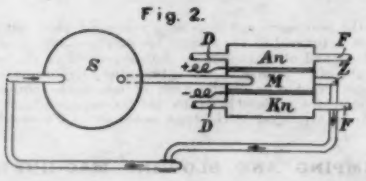


Fig. 2.



An and Kn by an anodic and a cathodic diaphragm respectively of suitable potencial. The anode is contained in the side chamber An and the cathode in the side chamber Kn. The frames forming the several chambers are held together in the manner of a filter press. The water under treatment leaves the middle chamber through an overflow at Z and is returned by a pump P to the tank S. In order that during the electrolytic treatment of the water to be purified the electrolytes migrating to the anode and cathode may not become very concentrated, there is a continuous flow of the water supply through the side chambers An and Kn. This washing water, which removes the electrolytic decomposition products of the water in the middle chamber, enters at D and leaves at F. The degree of salt removal is controlled by the duration of the operation and by the electromotive force used. The current density is approximately 1/600 ampère per square centimetre.—*February 20th*, 1924.

MISCELLANEOUS.

211,049. May 11th, 1923.—Splash Lubrication, J. H. Hons and the Heatly-Gresham Engineering Company, Limited, Letchworth.

This specification covers two systems for supplying lubricating oil to the crank pin bearings of reciprocating engines. In the case illustrated, the transverse trough A, provided for supplying lubricant to the usual connecting-rod dipper B,

No 211,049

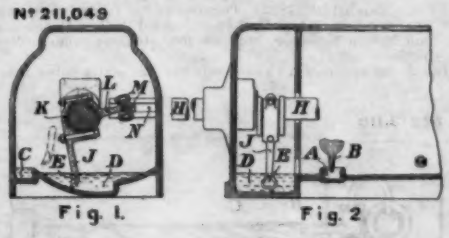


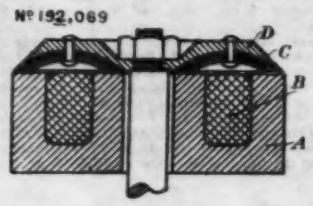
Fig. 1. Fig. 2

is fed from a longitudinal channel C, which in turn is fed from a well D mainly below the level of the crank chamber by a lifting device which consists of a spoon-like element E formed on an arm J journalled on a crank pin K on the crank shaft, and guided by an integral tail piece L pivoted on a block M sliding in horizontal guides N in the crank case.—*February 14th*, 1924.

192,069. January 20th, 1922.—Improvements in and relating to Electro-magnets, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse Stuttgart, Germany.

This specification describes an electro-magnet suitable for electric hooters and other arrangements which demand the use of a light armature. The magnet consists of a core A in which a coil B is laid. The armature consists of iron parts C necessary

No 192,069



for guiding the magnetic flux. The armature is covered by means of light metal D, such as aluminium. When an electric hooter is constructed on these lines the note can be strengthened and also be made more penetrating without using much electrical energy. It will be understood that the diaphragm of the hooter is connected to the central spindle which passes through the magnet.—*February 28th*, 1924.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

We are asked to announce that the office of La Vie Technique, Industrielle, Agricole et Coloniale, has been transferred from No. 16 to No. 14, rue Séguier, Paris, 6e.

We are asked to state that the telephone number of the London office of Vickers-Petters, Limited—75b, Queen Victoria-street, E.C. 4—has now been altered to Central 6156.

Lionel Robinson and Co., of 3, Staple-inn, London, W.C. 1, ask us to announce that they have added an additional telephone line—Holborn 6322—to their existing line, Holborn 6323.

We are asked to state that Mr. A. M. Bell, M.I. Mech. E., carriage and wagon superintendent, Great Indian Peninsula Railway, having proceeded on leave prior to retirement, Mr. Leslie Platt, A.M. Inst. C.E., M.I. Mech. E., M.I.L.E., has been appointed to act.

Ruston and Hornsby, Limited, of Lincoln, ask us to state that to meet the demands of their Irish business they have opened new offices and showrooms at 190, Pearse-street (formerly Great Brunswick-street), Dublin. Telegrams, "Rusornby, Dublin;" telephone, Dublin 4055. Mr. T. C. Ives, A.M.I. Mech. E., who has been with the firm for many years, will be resident manager.

Watson, Saville and Co., Limited, of Sheffield, inform us that the agency agreement between Mr. J. F. Melling and themselves has expired, and that it has been decided that it shall not be renewed. Mr. J. F. Melling, however, remains a director of the company. The company has arranged with Messrs. Bernard Holland and Co., 17, Victoria-street, Westminster, S.W. 1, to take over the agency from April 1st. Mr. B. A. Holland has been appointed a director of Watson, Saville and Co., Limited.

R.I.B.A. Diploma in Town Planning.—The examination for the R.I.B.A. Diploma in Town Planning will be held for the first time on Wednesday, Thursday, and Friday, October 15th, 16th, and 17th, and on Monday, October 20th, 1924. Candidates applying for admission must be either fellows, associates, or licentiates of the R.I.B.A., and applications must be made before May 31st, 1924. Forms of application for admission containing the regulations and syllabus may be obtained at the R.I.B.A.

Royal Institution.—A general meeting of the members of the Royal Institution was held on Monday afternoon, April 7th, Sir James Crichton-Browne, treasurer and vice-president, in the chair. The secretary reported the death of Dr. Donald Hood, a former manager and vice-president, and a resolution of condolence was passed. The Duchess of Bedford, Dr. Borns, Dr. J. C. Crocker, Mrs. Adams Frost, Mr. A. P. Griffiths, Sir Samuel Instone, Dr. David T. MacLeod, Mr. Stephen Miall, Sir Humphry Davy Rolleston, Mr. James H. Scrutton, Sir John Simon, P.C., Miss Florence Stawell, Mr. Arthur Taylor, and Lady Webb were elected members.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institute of Marine Engineers.—85-89, The Minories, Tower-hill, London, E. 1. Annual general meeting. 6.30 p.m.

Institute of Metals: Sheffield Local Section.—The University, St. George's-square, Sheffield. Annual general meeting. Paper, "The Protection of Aluminium by Electroplating," by Mrs. A. Vellan and Professor C. H. Desch, F.R.S. 7.30 p.m.

Institution of Locomotive Engineers.—College of Technology, Sackville-street, Manchester. Lecture, "Some Impressions on the Manufacture of Superheaters," by Mr. R. W. Whittle. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, London, S.W. 1. "The Relation of Air Consumption to Brake Horse Power in Internal Combustion Engines," by Dr. H. Moss. 6 p.m.

Institution of Naval Architects.—Royal United Service Institution, Whitehall, London, W.C. 2. Annual general meeting (conclusion). For programme see page 342.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Discussion on Mr. J. M. Jockel's paper, "Water-tube Boilers." 7.30 p.m.

Physical Society of London.—Imperial College of Science, South Kensington, London, S.W. 7. Ordinary meeting. 5 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Colours, Stains and Dyes," by Professor Jocelyn Thorpe. 3 p.m.

West Bromwich Engineering Society.—Technical School, West Bromwich. Paper, "Pulverised Coal: Its Preparation and Use," by Mr. R. Jackson. 7.30 p.m

SATURDAY, APRIL 12TH.

Institute of British Foundrymen: Lancashire Branch.—Visit to the works of the London, Midland and Scottish Railway at Horwich. 2.45 p.m.

Institution of Municipal and County Engineers.—George Hotel, Limerick. Irish District meeting. 2 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, London, W. 1. "Leonardo Da Vinci as a Man of Science," (Lecture II.), by Dr. Charles Singer. 3 p.m.

MONDAY, APRIL 14TH.

Institution of Automobile Engineers: Birmingham Centre.—Chamber of Commerce, New-street, Birmingham. Paper, "Light Alloys for Pistons and Connecting-rods," by Dr. L. Aitchison. 6.45 p.m.

Institution of Mechanical Engineers: Graduates Section.—Storey's Gate, London, S.W. 1. "Mechanical Refrigeration for the Small User," by Mr. A. H. Fuller. 7 p.m.

TUESDAY, APRIL 15TH.

Institute of Metals: Birmingham Local Section.—Chamber of Commerce, New-street, Birmingham. Annual general meeting. 7 p.m.

Institute of Transport.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Lecture for graduates and students, "The Rating of Railways and Docks," by Mr. A. J. Brickwell. 5.30 p.m.

Institution of Automobile Engineers: Coventry Centre.—Railway Hotel, Coventry. Paper, "Light Alloys for Pistons and Connecting-rods," by Dr. Leslie Aitchison. 6.30 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. "The Barton Power Station of the Manchester Corporation, and the Transmission System in Connection therewith," by Messrs. Henry Newmarch Allott and Standen Leonard Pearce, MM. Inst. C.E.; and "Dalmarnock Electricity Works," by Mr. William Burnside, Assoc. M. Inst. C.E. 6 p.m.

Institution of Electrical Engineers: North Midland Students' Section.—Technical College, Bradford. "The Protection of Alternating-current Transmission and Distribution Systems," by Mr. R. J. Huntley. 7 p.m.

Institution of Engineers and Shipbuilders in Scotland.—Rankine Hall, Elmbank-crescent, Glasgow. Paper, "Sliding Cylinder Double-acting Diesel Engines," by Mr. J. C. M. MacLagan. 7.30 p.m.

WEDNESDAY, APRIL 16TH.

Institution of Civil Engineers: Students' Meeting.—Great George-street, Westminster, S.W. 1. "Reinforced Concrete and its Relation to Constructional Work," by Mr. William Whitridge Davies, Stud. Inst. C.E. 6 p.m.

Radio Society of Great Britain.—Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Transmitter and Relay Section meeting. Discussion on "Power Transformer Design." 6.30 p.m.

FRIDAY, APRIL 25TH.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Aluminium Electrical Conductors for Overhead Power Transmission," by Mr. H. G. Williams. 7.30 p.m.

TUESDAY, APRIL 29TH.

Institution of Electrical Engineers: North Midland Students' Section.—The University, Leeds. Annual general meeting. 7 p.m.

A Pulverised Coal, High-pressure Plant.—We have just received information that the Columbia Power Company in America has placed an order with the Fuller-Lehigh Company, of Fullerton, Pennsylvania, for a complete pulverised coal preparing, conveying and firing equipment to operate in conjunction with eight 1500 horse-power (nominal rating) Babcock and Wilcox boilers to be installed at the new Miami Fort power station. The equipment will include six 57in. Fuller-Lehigh gear-driven screen type pulverisers, two 6ft. 6in. Fuller-Kinyon pumps conveying the coal from the pulverisers to the weighing bins, and 10in. pumps distributing the fuel from the weighing bins to the boiler bins. Each boiler will be fitted with five Fuller triplex feeders driven by variable-speed motors. The boilers will have hollow walls without water screens, and will run in conjunction with economisers and air heaters. The operating pressure for the station will be 575 lb. and the total steam temperature about 725 deg. Fah. In the first instance the generator equipment will include two 40,000-kilowatt reheater turbines.